# The Journal

OF THE

AMERICAN DENTAL ASSOCIATION

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# THE REACTION OF HUMAN JAWS TO PROSTHETIC DENTURES

By Elbert Crosby Pendleton, D.D.S., M.D.S., Chicago, Ill.

THE subject of structural changes in edentulous human jaws has been discussed from time to time in dental literature. It appears that atrophy of the jaws as it affects denture retention and stability is the phase of tissue change that has attracted common interest. Investigators have only recently considered the possibility of alveolar bone regeneration or its repair after the loss of the natural teeth.

Pressure and pain resulting from wearing prosthetic dentures were recorded as early as 1836, by Clark, who associated masticating force with the factor of adapting the "plate" to the jaws.[1] Later, in 1869, Richardson observed irregularities in the upper jaw ridge, concerning which he wrote "In respect to the upper jaw, at least, there is no pressure exerted as would result in permanent irregularities in the ridge, for, as the latter recedes, in the process of resorption, it is more and more relieved from direct contact with the plate covering it."[2]

From The Foundation of Dental Research of the Chicago College of Dental Surgery.

Read before the National Society of Dental Prosthetists, Milwaukee, Wis., July 10, 1939.

In the discussion of McKevitt's paper, "Atrophy and Hypertrophy of the Maxillary and Mandibular Alveolar Processes and Their Effect on the Stability of Artificial Dentures," Walter H. Wright referred to changes in the denture supporting tissues by saying, "The residual ridges are normally subject to atrophy. When the teeth are lost the alveolar ridge has served its purpose, and thereafter it continues to atrophy with greater or less rapidity, this depending on the individual patient." Wright also said, "The lack of use ultimately leads to atrophic change and predisposes the alveolar tissue to rapid resorption after the dentures have been constructed."[3]

Tench expressed the opinion that "beyond question the vitality of bone and its ability to resist change under stress of masticating force are affected by the state of general health."[4] According to Turner, "It is common observation that resorption progresses more rapidly if no plate is worn; a fact attributed no doubt to mechanical stimulation through the crushing of hard foods between the alveolar surfaces themselves."[5] Hildebrand concluded that "the problem of load is a

clinical factor that may have advantageous as well as disadvantageous effects on bone."[6]

Grohs found:

The carrying of dentures brings about certain tissue changes in jaws. These changes indicate that under full dentures there is a certain transformation of bone as well as of soft tissue. Bone is resorbed in the areas of greatest pressure, and new bone is built in the areas of relief, the soft tissues become atrophic or hypertrophic, depending upon the stimulus to which it is subjected. These changes might be considered an adaptation of the jaw to the denture.[7]

Ten years ago, Stansbery expressed the process of an edentulous jaw being rebuilt, but I am inclined to believe that even though the process of resorption may be retarded, new ridges cannot be developed.[9]

According to MacMillan:

The alveolar process has a very definite function after the loss of the teeth and responds physiologically to the stimulus of artificial restorations. . . . Changes in bone are fundamentally due to physiological stimulation or lack of it.[10]

The character of the bone of edentulous jaws affords some basis for controversial opinions. Hopewell-Smith observed that "the alveolar processes are

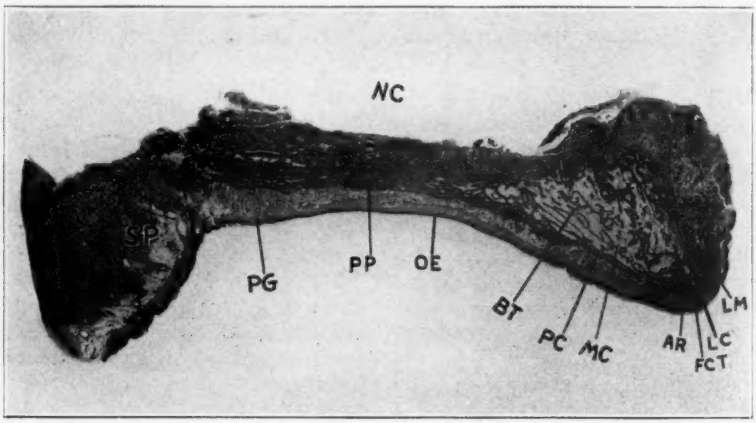


Fig. 1.—Sagittal section through right maxillary incisor region at residual alveolar ridge and hard and soft palate of man aged 63. NC, nasal cavity. LM, labial muscles. AR, residual alveolar ridge. PP, palatine process. SP, soft palate. LC, labial cortex of alveolar process. PC, palatine cortex of alveolar process. BT, bone trabeculae. MC, medullary cavity and bone marrow. OE, oral epithelium. PG, palatine glands. FCT, fibrous connective tissues.

opinion, based upon a study of the reaction of the oral tissues to dental prosthesis, that "it is not possible to correct detrimental tissue changes that have already taken place under dentures."[8] In the same year, Wright stated:

The denture plays an important part in the process of tissue change. . . . Atrophy of denture supporting tissues is due, no doubt, to pressure. No denture in reality maintains its original retention. Sooner or later it becomes loose. . . . I have never observed the

constructed of hard bone which is neither typically compact nor cancellous."[11] In edentulous jaws, this description seems valid. There are usually very few areas of typically cancellous bone. The whole of the internal bone structure, even in the presence of rather large medullary spaces, is of compact character; that is, haversian systems persist throughout many of the bone trabeculae.

Ham makes a nice distinction between cancellous and compact bone:

The two types of bone differ only in the degree of porosity. . . . Spongy or cancellous bone is limited chiefly to the interiors of bony structures which have an exterior covering of compact type. It demonstrates anastomosing trabeculae covered by endosteum which encloses relatively wide spaces and it shows no evidence of Haversian systems.[12]

In edentulous jaws, these nutritional canals appear to a greater or less degree throughout the interior of the bony structure of both the maxillae and the mandible.

The subject of bone as a connective tissue substance appears to excite controversy. As Key has said in his introduction to the English translation of Leriche and Policard's book, "The Normal and Pathological Physiology of Bone," "In the vast literature dealing with bone there is much that is obscure, unknown and mysterious."[13] Ham writes, "The literature of the studies made upon bone repair offers an amazing assortment of widely divergent opinions and conclusions"[14] According to Maximow, "The histogenesis of bone is complex and is explained differently by various authors."[15] It appears, therefore, that a certain degree of latitude must be granted the interpretation of any problem dealing with bone. This may be because, in the adult state in particular, and many studies have been conducted from such material, the adaptive quality of bone is influenced by many factors, some or all of which may be obscure. The weight of the preponderant influence in bone transformation can hardly be estimated. Therefore, it seems practical that an objective analysis of the material used in this study be made without concern as to the cause of the changes observed. The human jaws, like other bones of the skeleton, may be expected to respond to the various influences to which human life is subjected. Kronfeld states: "In bone a continuous process of elimination by resorption and replacement by newly formed bone takes place: thus, the total amount of adult bone remains fairly constant."[16]

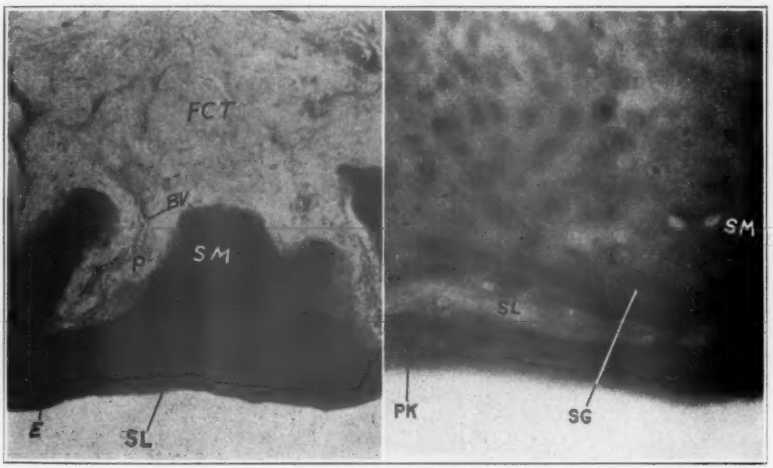


Fig. 2.—Oral epithelium and connective tissue from residual alveolar ridge in lateral incisor region. Left: E, surface layer of epithelium. SL, stratum lucidum. P, papillary layer. BV, blood vessel. SM, stratum malpighii. Right (higher magnification): PK, flattened cells in surface layer undergoing "parakeratotic" hornification. SL, stratum lucidum. SG, stratum granulosum. SM, stratum malpighii.

Functional stress, the mechanical factor in tissue change when dentures are worn, is generally recognized as a dominant influence on the structure of the bone tissue. According to Leriche and Policard:

> Bone is a tissue with a sluggish life. Physiologically, dead bone, with dead cells seems to have the same mechanical value as when it is living. . . . But as soon as it begins to resume activity, bone tends to disappear.[17]

Therefore, the degree of mechanical stimulus to which the bone of the jaws is subjected may be considered as the equation influencing its atrophy and regeneration. Ham says:

> The mechanism by which many of the functional processes take place in the bone is not well understood. There is no universally accepted concept of either the process of calcification of matrix or bone and cartilage resorption.[18]

Although it tends to diminish in importance in adult tissues, environment seems to be a factor in bone transformation, and the circulatory increase or vascular condition of the structures appears to be of considerable signifi-

Fig. 3.—Labial spur of bone plate at residual alveolar ridge in right lateral incisor region. AB, adult bone of labial cortex. YB, young bone lamellae. FCT, fibrous connective tissue covering residual alveolar ridge. LM, labial muscles. (Higher magnification of section shown in Figure 1.)

cance in the trend of bone formation.[19]

A general condition may be said to exist, associating the edentulous jaw and the mechanical influence of the prosthetic denture. First, the denture supporting tissues are predominantly subjected to intermittent pressures, as there exist alternate periods of pressure and rest; second, the soft tissues of the jaws exert a buffer-like influence that tends to minimize the effects of the pressure of the masticating forces; third, the soft tissues of the jaws supporting artificial dentures are provided with a lubricating agent, the secretions from the mucous glands. The presence of this viscid fluid between the mucosa and a conservatively adapted denture tends to create a semihydraulic action contributing to an equal distribution of strain and shock over the whole of the denture area. Therefore, it seems reasonable to assume that, for the most part, the mechanical action affecting edentulous jaws when prosthetic dentures are worn is conducive to the maintenance of an equilibrium between the processes of resorption and repair.

This report deals with changes in the bone and soft tissues of an upper and lower jaw that, during life, supported complete artificial vulcanite dentures. The subject was a man who died at the age of 63 years and the evidence indicates that the prosthesis had been worn for perhaps a considerable time. This conclusion was reached after examination of the polished occlusal facets on the teeth of the maxillary denture that could have been associated only with functional wear. Because of these facets, it has been concluded also that both the maxillary and the mandibular denture were worn, although only the maxillary denture was obtained with the necropsy material.

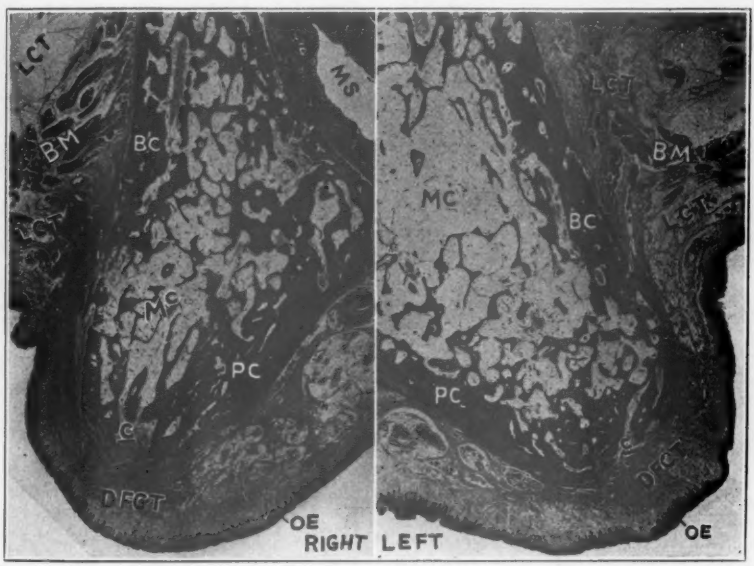


Fig. 4.—Right and left bicuspid regions. LCT, loose connective tissue of vestibule. BM, buccal muscles. BC, buccal cortex. PC, palatine cortex. MS, maxillary sinus. MC, medullary cavity with fatty bone marrow. DFCT, dense fibrous connective tissue at residual alveolar ridge. C, channel in residual alveolar ridge communicating with medullary cavity.

The teeth used in the construction of the denture were of anatomic form. The denture had no features of exceptional quality.

The histologic material was prepared in a sagittal plane including the anterior portion of the edentulous arch from cuspid to cuspid areas. This series of sections includes the labial soft tissues, the residual alveolar ridge and the hard and soft palate regions. The bicuspid and molar regions were prepared in a frontal plane and include the buccal soft tissues, the residual alveolar ridge and a portion of the palatine structures. The serial sections were stained with hematoxylin and eosin.

The soft tissues have a surprisingly healthy appearance in view of the character of the prosthetic denture with which they were associated. The bone marrow is of the static fatty type, free from traces of inflammation. The connective tissues covering the residual alveolar ridge appear densely fibrous, particularly near the bone. Bundles of wavy white fibers are found extending in a perpendicular direction through and between the dense fibers of the connective tissue. They follow a course parallel to the external surface of the residual alveolar ridge. A loose connective tissue containing a considerable amount of fatty substance is found in the palatine region and about the musculature. (Fig. 1.)

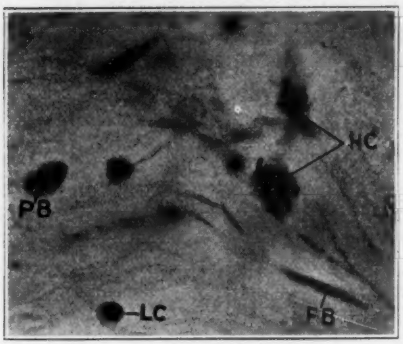


Fig. 5.—Connective tissue found in channel through residual alveolar ridge. (Higher magnification of C, Figure 4.) LC, lymphocyte. FB, fibroblasts. HC, histiocyte. PB, polyblast.

A general consideration of the epithelium reveals a cornified surface layer at the residual ridge and in the region of the hard palate. The labiobuccal vestibule and soft palate surfaces are covered by a delicate mucosa. In some areas of the ridge, a stratum lucidum may be found accompanied by a condition of "parakeratotic" cornification.[20]

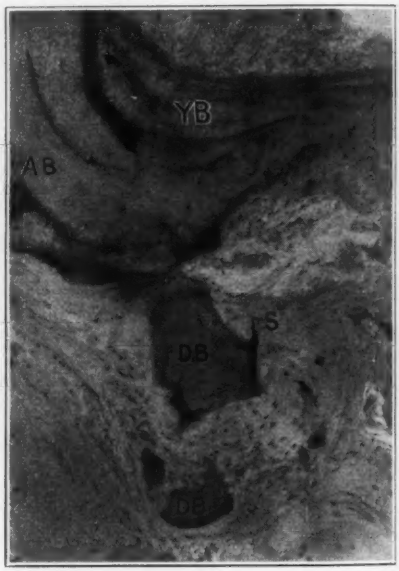


Fig. 6.—Palatine surface of residual alveolar ridge in left bicuspid region. DB, dead bone particles. AB, adult bone of residual alveolar ridge. YB, area of young bone formation. S, spur of dead bone. (Higher magnification.)

This structure, common to the skin but uncommon in oral epithelium, has been observed only in this study.[21] The stratum lucidum is thought to be a precursor of the stratum corneum, which is derived from degeneration of keratohyalin granules in the stratum granulosum.[22] (Fig. 2.)

The connective tissue, like the bone marrow, is free from inflammatory processes. It seems that, in edentulous jaws, both structures are a very sensitive register of inflammation and one is seldom affected independently of the other. Inflammation and resorption, while unrelated, according to Leriche and Policard, appear to have common predisposing influences.[23] These factors are (1) the nature and intensity of the stimulant which may become an irritant; (2) the duration of the stimulant, and (3) the health or resistance of the individual affected.

ridge. About one-third of the inferior portion of the labial spur consists of newly formed bone. (Fig. 3.) At this spur formation, the periosteum appears slightly hypertrophic, with a thickening of the osteogenic layer of cells between the fibrous layer and the bone. Changes in the palatine process are not marked in any of the sagittal series. However, there are evidences of a moderate bone transformation.

At the alveolar ridge, profound changes are recorded in the bone structure. At some period during life, resorption was undoubtedly active, but, at

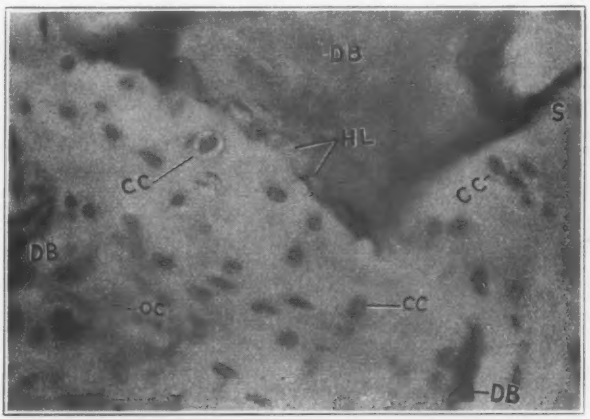


Fig. 7.—Osteogenic cells in newly formed matrix surrounding dead bone particles. CC, cartilage-like cells. DB, dead bone. HL, old Howship's lacunae. S, spur of dead bone. OC, osteogenic cells. (Higher magnification of Figure 6.)

THE BONE AND SOFT TISSUES

The residual alveolar ridge and the palatine process in the incisor region have a characteristic form. The palatine portion of the residual alveolar ridge is dense, while the labial cortex is somewhat frail in appearance. The external surfaces of the bone are unusually irregular in outline. However, no active resorption appears. There are evidences of old Howship's lacunae along the external plates of the older bone structure, indicating that resorption had taken place.

Regeneration of the labial cortex is evident near the midline at the alveolar

the time of death, a regeneration of the bone was in progress. The bone cells were for the most part vital, this indicating that a state of calcium stability existed in the bone matrix.[24] This evidence eliminates the process of absorption as a factor in the transformation of the bone in this material.

There is a striking contrast in the bone in the bicuspid regions on the two sides of the jaw. (Fig. 4.) A dense structure is presented by the right side. The palatine cortex is thick and smooth and the buccal is thin and irregular. Along the buccal cortex are areas with

unusual circumferential lamellae situated above the line of cheek reflection. Below the line, the plates are thin and, like the residual alveolar ridge surfaces, their continuity is interrupted by channels communicating with the medullary spaces. The bone trabeculae are strong and closely interwoven. They extend in a general direction upward from the palatine to the buccal cortex. The medullary spaces are small and the bone marrow is of the fatty type.

The buccal and the palatine cortex on the left side of the jaw, by comparison, do not vary greatly in width. The external surface of the bone is quite irregular and its compact structure contains many haversian systems. The greatest thickness in the cortex is found at the palatine aspect of the residual ridge, which may be interpreted as an area subjected to great stress, and the frailest portion is at the inferior labial cortex. The bone trabeculae are frail and irregular except at the crest of the alveolar ridge, and it appears that none are continuous from the lingual to the buccal surface. The medullary spaces are large and the marrow is of the fatty type. This similarity of the bone marrow on the two sides suggests but one conclusion, the absence of either inflammatory or degenerative processes in the tissues.

The soft tissues also display variable characteristics on the two sides of the jaw. The musculature in the bicuspid region reaches its greatest development on the right side of the arch. Here, the loose connective tissue about the buccinator muscles is correspondingly reduced in volume as compared with the left side of the jaw. Dense fibrous connective tissue covers the residual alveolar ridge, and only in this region of the right side does it extend along the buccal wall to the attachment of the muscles. The loose connective tissue of the palate is somewhat thicker and contains more fatty tissue on the right than on the left side of the arch. The connective tissue extending into the openings through the bone cortex of the residual

**Fig. 8.—Area of active transformation of bone tissue at palatine surface in right bicuspid region. AB, adult bone of palatine process. HL, old Howship's lacunae. OT, osteoid tissue. OB, osteoblasts. HT, hyaline tissue band. OC, osteogenic cells. FCT, fibrous connective tissue. CC, cartilage-like cell. (Higher magnification.)**

alveolar ridge is fibrous in character and is free from the cell types found in inflamed connective tissue. (Fig. 5.)

Active regenerative changes existing at the external surfaces of the residual alveolar ridge may be related to the variable nature of the internal bony structures, which are frail in some regions and compact in others. Frail interiors are invariably accompanied by compact exterior surfaces, or they may demonstrate active processes of transformation. Compact interiors often seem to be associated with frail exterior surfaces. According to Grohs' interpretation, areas of traumatic injury are found at or near the palatine surface of the residual alveolar ridge.[25] These areas are common at the palatine surfaces throughout the series of histologic sections. (Fig. 6.)

Small particles of dead bone are found in the connective tissue closely approximating the adult bone of the residual alveolar ridge where trauma may have been the cause of the transformation. Surrounding these particles of dead bone is a preosseous substance in which the specialized connective tissue cells, spoken of by Ham as osteogenic cells, have the appearance of progressing in their differentiation toward the formation of both bone and cartilage.

In this report, Ham's terminology is used to indicate these differentiating connective tissue cells as osteogenic cells, and those highly specialized as osteoblasts. According to Ham:

> It is obvious that osteogenic cells must be considered as having rather wide capabilities of differentiation . . . to designate an osteogenic cell as an osteoblast is rather misleading as it implies a degree of specialization which the cell has not yet attained. The term osteoblast should be reserved for cells which are actively surrounding themselves with a matrix of a bony character which is indicative of the fact that the cell is completing its differentiation and is shortly to become an adult bone cell.[26]

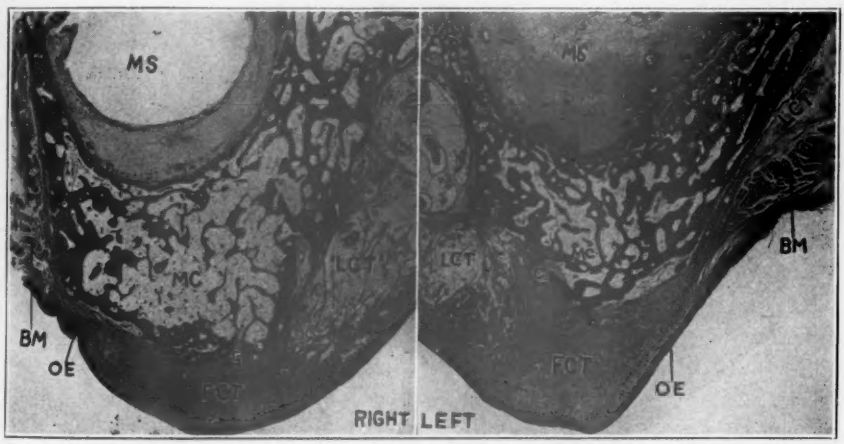


Fig. 9.—Right and left molar regions. FCT, fibrous connective tissue at residual alveolar ridge. OE, oral epithelium. LCT, loose connective tissue at palate and vestibule. BM, buccinator muscles. MC, medullary cavity. C, channel in residual alveolar ridge leading to marrow cavities. MS, maxillary sinus.

Old Howship's lacunae may be recognized on the inferior surface of the dead bone particles by aid of the high power of the microscope. The adult bone of the residual alveolar ridge adjacent to these dead bone particles contains osteocytes in its lacunae, while, in the dead

bone, the old Howship's lacunae contain osteoid tissue. This osteoid substance, an immature bone matrix, is common to growing areas. Here, it completely surrounds the dead bone and extends for some distance to the fibrous connective tissues covering the residual alveolar ridge. In the discussion of "The Mechanism of Resorption in Creeping Replacement of Bone," Ham says, "The factor of pressure must also be considered in the process because pieces of dead bone or cartilage matrix often become completely surrounded by a new bone formation."[27] (Fig. 7.)

A transformation of the palatine surface is seen on the right side of the arch in the bicuspid region. What may be recognized as old Howship's lacunae in the adult bone have been replaced with bone matrix. Large young bone cells occupy the irregular spaces created by a once active resorption. A band of hyaline structure quite unusually distinct separates the new bone from the osteogenic layer of cells. In the connective tissue substance, there are many transitional forms of the connective tissue cells, in which an occasional cartilage-like cell also may be found.[28] The whole process in this picture suggests its similarity to the early bone formation in fractures. According to Ham:

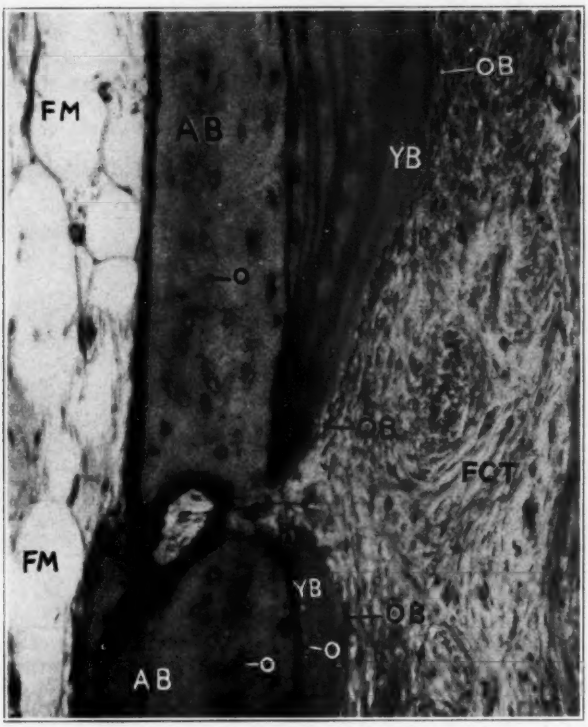


Fig. 10.—New bone formation along buccal cortex. YB, young bone. OB, osteoblasts. FCT, fibrous connective tissue. AB, adult bone. O, osteocyte, adult cell with evenly stained, dark nucleus appearing shrunken, indicating vitality of bone. FM, fatty bone marrow.

It is interesting to note that this early type of bone formation results from a differentiation of the osteogenic cells into bone cells in

a process identical with that seen in membrane bone formation. This early bone formation in the repair of fracture is, moreover, closely associated with vascularity, as in membrane bone formation.[29] (Fig. 8.)

The residual alveolar ridge form and the characteristics of the internal bone structure in the molar regions are of noticeable contrast to those seen in the bicuspid region. Here, no perceptible variation exists in the thickness of the cortical plates at the buccal and palatine surfaces. The compact character of the interior structure is peculiar to the bone on the left side, whereas this condition was present on the right side of the jaw in the bicuspid region. The bone structure on the right side certainly should not be considered frail, as many of the trabeculae have a rugged appearance. However, those of the left side have a definite continuity lacking in those on the opposite side of the arch. On both the right and the left side of the jaw, the trabeculae show many ground lamellae characteristic of the concentric plates of the bone forming the haversian canals.[30] (Fig. 9.)

The rebuilding process in the bone appears to have been active along the external surface of the buccal cortex and at the crest of the residual alveolar ridge. New bone formation consisting of numerous layers of circumferential lamellae at the buccal cortex reinforce a well-organized adult bone in which all of the lacunae were occupied by bone cells. Likewise, in many locations, the crest of the residual alveolar ridge was in an active state of development.

Fig. 11.—New bone formation at residual alveolar ridge in molar region. AB, adult bone. O, osteocyte in bone lacunae. OB, osteoblast, young bone cell in osteoid tissue. OB, osteoblasts lining osteoid tissue. OC, osteogenic cells appearing in columns. FCT, fibrous connective tissue.

The process of bone transformation observed is typical of intramembranous bone formation. Again quoting Ham: "Intramembranous bone formation does not occur in a massive fashion, but rather it is seen to begin in many isolated points and the first formed matrix is relatively small in amount."[31]

The new bone formation at the residual ridge suggests the typical forma-

tion of primary membrane bone. The vital adult bone is surrounded by osteoid tissue in which some of the young bone cells, osteoblasts, are included in the interstitial substance which they produced. (Fig. 11.)

The border of the osteoid tissue is lined with osteogenic cells and others more specialized which had progressed in their differentiation far enough to be considered osteoblasts. Maximow and Bloom, Todd and others agree as to the origin of the osteoblasts that, in the adult, these cells arise from the transformation of

cation. According to Maximow and Bloom, "This reconstruction of bone is based entirely on the activity of osteoblasts and osteoclasts."[35] (Fig. 12.) Growing bone plates are found at the external surface of the residual ridge where the bulk of the new bone originates from the periosteum. Likewise, along its inner surface, which forms the boundary of the bone marrow cavity, a moderate development of similar type is also found. Maximow and Bloom have said "In the adult organism the source of the new formation of bone is the peri-

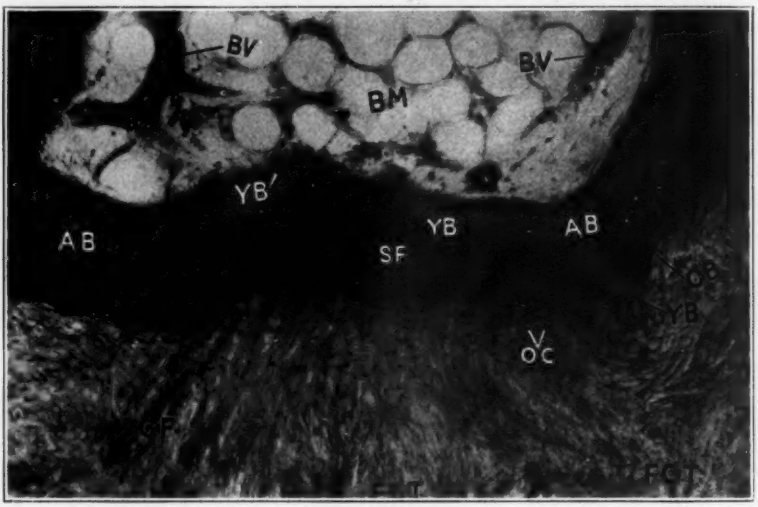


**Fig. 12.—Residual alveolar ridge in molar region with both periosteal and endosteal bone development. YB′, young bone, periosteal development. YB, endosteal bone development. OC, osteogenic cells arranged in columns. CF, collagenous fibers radiating from adult bone structure into fibrous connective tissue. BV, blood vessel. BM, bone marrow. AB, adult bone of alveolar ridge. FCT, fibrous connective tissue. OB, osteoblasts lining periosteal development of young bone at external surface of adult bone. SF, area of adult bone in which Sharpey's fibers appear.**

fibroblasts.[32] Todd thought they "may or may not have passed through a 'chondroblast' stage,"[33] and that "their number is kept constant by the addition of cells from the connective tissue."[34]

In the region of the maxillary tuberosity, the cortex of the alveolar ridge exhibits processes of bone formation typical of periosteal and endosteal ossifi-

osteum and, to some extent, the endosteum."[36] According to Ham:

The growth of membrane bone is dependent on the mitosis of the reserve or osteogenic cells, and on the differentiation of a portion of the products of division into bone cells. . . . The growth of membrane bone in post-natal existence being largely accounted for by the proliferation of the

osteogenic cells which line the bone on its various aspects.[37]

At the outer surface, closely associated bundles of collagenous fibers extending from the periosteum penetrate the bone substance, and others continue into the connective tissue. The fibers (Sharpey's) entering the bone may be seen by the aid of the high power of the microscope. In areas where bone formation was active, the connective tissue appears hyperplastic. This connective tissue proliferation often assumes considerable proportions and its form corresponds to that of the adult bone with which it is associated. Its osteocollagenous fibers usually have a "felt-like" arrangement. In other areas, they radiate from the bone into the fibrous connective tissue. The osteogenic cells have a tendency to arrange themselves in rows or columns suggesting endochondral bone development. It is unusual to observe endosteal bone development in edentulous jaws. However, along the border of the residual alveolar ridge at its inner surface, such a process with a vascular bone marrow is seen in the field of this transformation. The surface of the newly formed bone, on both the inner and the external surfaces of the residual ridge, has an irregular outline, with scattered osteocytes in the interstitial bone substance.

### BONE REGENERATION IN THE MANDIBLE

The processes of bone transformation in the mandible vary somewhat from those in the maxillae, as both active resorption and repair had prevailed. In the posterior regions of the residual alveolar ridge, resorption predominates, while both resorption and new bone formations are demonstrated in the anterior regions of the arch. That the process of repair was not limited to the period in life im-

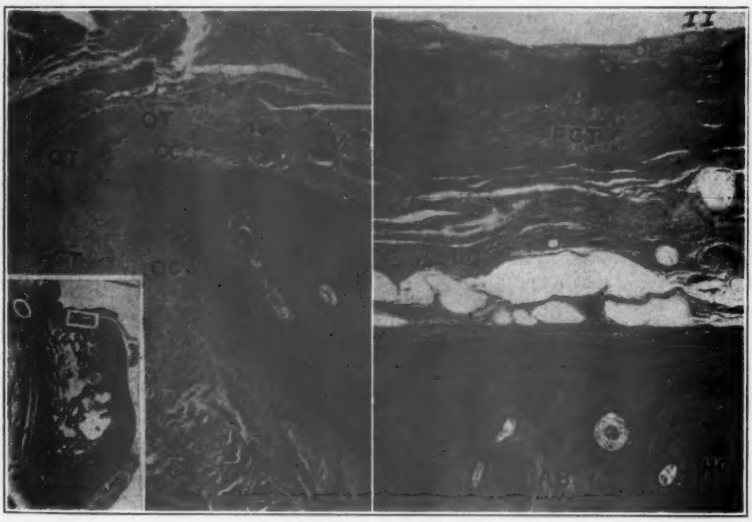


Fig. 13.—Incisor region at lingual aspect (I) and crest of residual alveolar ridge (II) of mandible. Insert: The oval indicates section I, showing the lingual spur of the mandible. AB, adult bone. YB, young bone. OT, osteoid tissue. OC, osteogenic cells. FCT, fibrous connective tissue. BV, blood vessels. The rectangle indicates section II, showing crest of residual alveolar ridge. AB, adult bone. HC, haversian canals. YB, horizontal circumferential lamellae of young bone. LCT, loose connective tissue. FCT, fibrous connective tissue. OE, oral epithelium.

mediately preceding death may be concluded from the apparent maturity of the circumferential lamellae at the residual alveolar ridge in the incisor region. The number and development of its young bone plates seem to indicate that the bone had been inactive for a time, as no osteogenic cells line its surfaces. The outline of the older bone is distinctly marked by its irregular surface, which has every indication of being at one time a series of Howship's lacunae. (Fig. 13.)

New bone in an active state of formation is seen at both the superior and the inferior surfaces at the lingual aspect in the anterior portion of the residual alveolar ridge. The connective tissues close to the mandible are very dense, and the increase of the mass of cellular elements suggests their proliferative activity. On the superior surface at the lingual aspect of the mandible, the adult bone is covered by osteoid tissue in which young bone cells appear. Its surface is lined with osteogenic cells and the connective tissues are quite vascular.

A similar picture is seen at the inferior surface even though the connective tissues occur avascular. The osteogenic cells appear in a variety of shapes and forms that are interpreted as a sign of their transition in the process of matrix formation. (Fig. 14.)

### INTRAMEMBRANOUS BONE FORMATION IN THE EMBRYO AND THE ADULT

Fields were chosen from the latest growing zone in the maxilla of an embryo at the fourth month and also from the subject of this report, a man in the sixty-third year of life, for the purpose of studying the processes of intramembranous bone formation from both adult and embryonic connective tissues. (Fig. 15.) From the adult, the location of the field is below the attachment of the

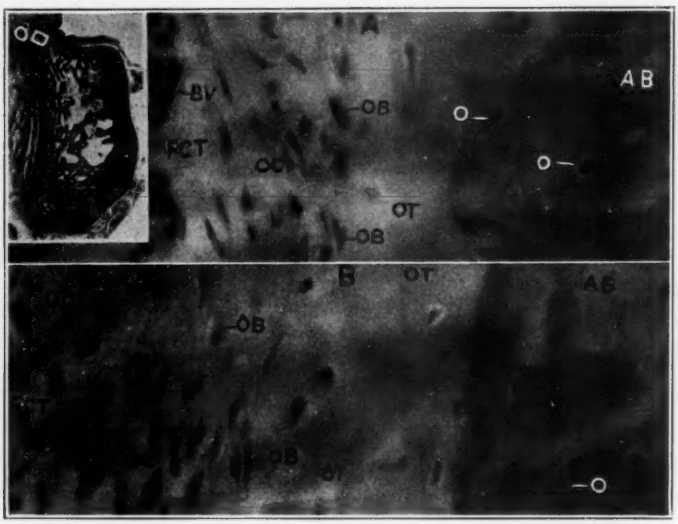


Fig. 14.—Higher magnification of Figure 13, I; showing growing zones at lingual surfaces of mandible, indicated by outlined areas in insert. Above (A): Field (rectangle) at superior surface. AB, adult bone. O, osteocyte. OB, osteoblasts lining and included in osteoid tissue. OT, osteoid tissue. OC, osteogenic cells. FCT, fibrous connective tissue. BV, blood vessells. Below (B): Field (oval) at inferior surface. AB, adult bone. O, osteocyte. OB, osteoblasts. OT, osteoid tissue. OC, osteogenic cells. FCT, fibrous connective tissue.

muscle at the buccal cortex of the residual alveolar ridge in the molar region. (Fig. 15, I.) From the embryo, a similar area is shown at the inferior surface of the palatine cortex of the alveolar process in the premolar region. (Fig. 15, II.) It is true that histologic pictures comparable in detail might have been secured had a field been chosen from the embryo where older bone is found at a position near the base of the alveolar process.

The histologic pictures of these growing zones last formed in the two specimens present a striking similarity. Their variation appears in the degree of organization of their interstitial substance. In the primary bone of the embryo, the bone cells have elongated oval forms that appear united by threadlike processes. The cells are surrounded by a dense capsular substance, giving them the appearance of cartilage cells, and the lacunae in which they are housed lack regularity in form and arrangement. The capsule resembles imperfectly calcified or young bone matrix, a kind of condensed colloidal substance not unlike hyaline tissue. In the osteogenic layer, the lining cells are prolific. They have irregular oval forms. However, transitional star shapes among them are lacking. Occasional cells having a darkly stained nucleus may be seen.

In the newly formed bone in the adult, the young bone cells appear oval with large nuclei in which even-staining cromatin particles are present. A few osteoblasts are scattered along the surface of the newly formed bone substance. Among the osteogenic cells lining the osteoid tissue, occasional star-shaped cells may be found. If the number and size of osteogenic cells are accepted as an indication of the degree of their potentiality, it may then be assumed that they lack somewhat the regenerative capability of the embryonic tissue.

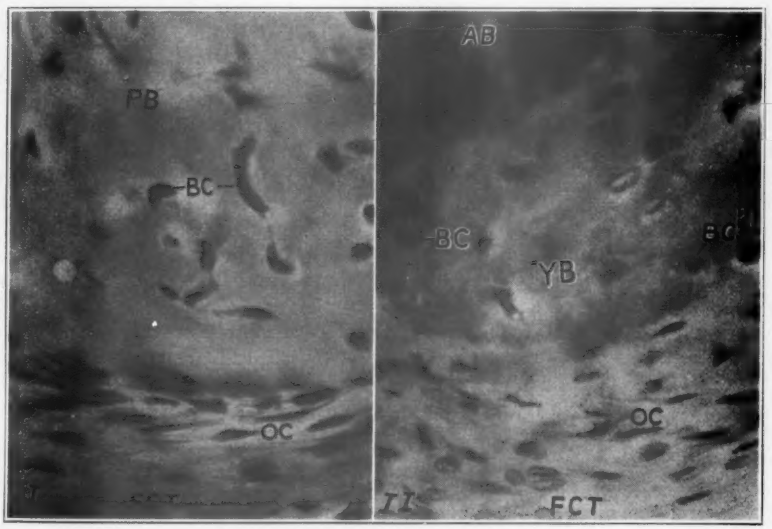


Fig. 15.—Growing zones of intramembranous bone at inferior surface of palatine cortex of alveolar process from embryo at fourth month (I) and buccal cortex of residual alveolar ridge from man aged 63 (II). PB, primary bone matrix. BC, bone cell. OC, osteogenic cells. FCT, fibrous connective tissue. AB, adult bone matrix. YB, young bone.

## CONCLUSION

Under favorable conditions, it appears that the residual alveolar bone in edentulous human jaws is capable of structural adaptation when the tissues support prosthetic dentures. It is significant that the new bone formation found in these tissues was preceded by a process of resorption, and both the bone marrow and the connective tissues were free from the influence of inflammatory processes. Likewise, the development of epithelium with layers similar to those of the skin may have a significance relative to the bone changes as both appear in tissues free from inflammation.

The transformations of the connective tissue substance in the adult are comparable, histologically, to the processes of membrane bone formation in the embryo. The environmental influence, such as the vascularity of the tissues, which is known to be a factor in the development of bone, may be responsible for the peculiarities in form, character and arrangement of the cellular elements observed in the growing zones. The distribution of the growing zones to unrestricted areas of the labiobuccal and palatine surfaces and the crest of the residual alveolar ridge in both the mandible and the maxillae suggests a general condition of repair existing in the tissues.

The new bone may be considered as the effect of a series of conditions that followed resorption, which left its mark in the adult bone. No signs of the cause of this resorption have been identified. Resorption is recognized as a normal biologic process closely associated with circulatory increases.

It would seem that to conjecture as to the cause of the variations in the bone architecture in edentulous jaws would be useless. It is possible that conditions which preceded the loss of the natural teeth were responsible for the frail character of the internal bone structure on the left side of the arch in the bicuspid region and on the right side in the molar region. It is known that periapical and periodontal disease could have been responsible for the disparity seen in the width and form of the cortical plates of the residual alveolar ridge. Functional adaptation of the bone offers another possible explanation for the variations encountered. New bone, osteoid tissue, hyaline substance and the connective tissue substance present a picture of regeneration that follows a normal biologic trend.

Three processes, similar but not identical, represent phases of new bone formation that may be mechanisms influenced by factors of environment. They are: first, the transformation of the connective tissue substance because of a differentiation of the connective tissue cells in a manner similar to the development of primary bone in the embryo; second, the development of an osteoid substance in which cartilage-like cells exist together with particles of dead bone that presumably resulted from traumatic injury, and third, the reconstruction of a well-organized adult bone tissue affected by mechanical factors, which demonstrates processes of periosteal and endosteal ossification.

## SUMMARY

The atrophy of human jaws has long been considered a factor of grave concern in the problem of tissue changes under prosthetic dentures. Throughout dental literature, these degenerative processes are associated with the mechanical factors of pressure. Their action, generally speaking, may have been misinterpreted with relation to the prosthetic problem, as the pressure exerted by masticating action is not continuous, but intermittent. Intermittent pressure is said to be a physiologic stimulant. Excessive or continuous pressure causes irritation, inflammation and possible degenerative tissue changes. In the problem of tissue reaction to prosthetic dentures, the equal

distribution of pressure to all supporting structures is an important factor. This distribution is served by the presence of a semihydraulic agent, the mucous secretions between the prosthetic denture and the supporting tissues.

The histologic material for this study included the upper and lower jaws from a man 63 years old. In the maxillary denture, procured with the jaw material, the polished facets on the teeth indicate that both the maxillary and the mandibular dentures were worn for a considerable period of time.

A microscopic examination of serial sections prepared in both a sagittal and a frontal plane disclosed no evidence of pathologic change. New bone formation prevailed in unrestricted areas throughout the residual alveolar bone and the palatine process. The growth of bone was apparently preceded by resorption. Areas of traumatic injury, evidenced by particles of dead bone in the connective tissues, were surrounded by new bone formation. A general condition of bone transformation prevailed throughout the area of denture support. The processes of bone development appear comparable to the primary formation of intramembranous bone in the embryo.

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# RELATIONSHIP OF DENTAL SEPSIS TO SYSTEMIC DISEASE*

By Louie T. Austin, D.D.S., Rochester, Minn.

CONSIDERABLE confusion exists in the minds of the members of the dental profession today as to the effect of dental sepsis on health. Occasionally, patients report complete relief or marked improvement in their general condition following the elimination of dental infection. On the other hand, patients with what seems to be a parallel condition may not be benefited at all by the same procedure. Since the active general practitioner has approximately 1,000 patients, his experience in this regard is limited, and the reaction of the dentist to the dental focal infection theory might be classified as overenthusiastic, center of the road or doubtful.

Many members of both the medical and the dental profession at first were overenthusiastic about the dental focal infection theory, and later results have been disappointing to the group as well as to their patients; and, undoubtedly, those who have questioned the importance of dental infection have had experiences that have altered their former opinion.

Experience is the factor that has altered opinion, and, as time goes on, further truths will develop. Certainly, no dentist is in a position to judge the effect, whether beneficial or otherwise, of dental infection on disease in such organs as the stomach and heart, or in nerve tissue, etc. Treatment of such disease is complicated, and in many instances in which credit is given to dental treatment, the improvement may be due to other factors in the treatment.

When asked by a patient if the removal of an affected tooth will cure a particular type of disease, whether it involves the kidney, the heart or the joints, those of us who are directly concerned with sick people have learned to make few predictions. It is much better to inform the patient that our efforts are being directed toward improvement of his general well-being and with the hope that he will be benefited indirectly.

Since opinions are not fixed, it was of interest to obtain the present ideas of consultants in various sections of The Mayo Clinic regarding the relationship of dental sepsis to their particular fields.

The following short notes from various consultants are quoted:

George B. Eusterman, senior consultant in the Section on Gastro-Enterology, said:

> While the actual cause of chronic peptic ulcer still appears to be an obscure one, I think that the clinical, experimental and pathologic evidence is sufficient to say that foci of infection in the mouth, particularly periapical infection, can give rise to the following conditions: gastric submucosal hemorrhage and hemorrhagic erosion, which may be symptomless other than giving rise to occult and gross bleeding; acute ulcers of the stomach or duodenum; acute and subacute gastritis, which may also give rise to symptoms and signs simulating peptic ulcer, even hemorrhage; subacute ulcers of the stomach and duodenum, and, in many cases, indigestion, which may or may not simulate ulcer and which may disappear

*From the Mayo Clinic.

Read at the Meeting of the District of Columbia Dental Society, Washington, D. C., January 9, 1940.

with the removal of foci. Chronically infected tonsils may be put in the same category.

As to whether dental infection may be the sole cause of a chronic ulcer, I am not prepared to say. I feel that it may be the actual starting point of an ulcer, but other factors must be present to make the ulcer chronic, as acute processes in the gastric mucous membrane tend to heal readily, other things being equal. I don't see how any conscientious practitioner or specialist, in the light of present knowledge, can ignore the importance of dental infection in the presence of disorders or disease of the upper part of the digestive tract. If he assumes any other attitude, I feel that he is doing an injustice to his patients and to medicine in general.

The duodenum, from the standpoint of chronic ulceration, is the commonest site of gross disease in the upper part of the digestive tract.

I would suggest that Dr. Eusterman's recent article, "Modern Concepts of the Etiology of Peptic Ulcer and Their Bearing on Therapy," be read for further information.

Regarding the lower portion of the digestive tract, J. A. Bargen said:

There are a number of conditions of the intestinal tract that are related to dental infection. Foremost among these, probably, is the streptococcal type of ulcerative colitis. Here, the relationship has been clearly shown experimentally and clinically. Removal of periapical infection and perhaps even removal of pulpless teeth are of great importance in many cases. Other less serious conditions, even the presence of an irritable bowel, are affected favorably by the care of the mouth. Extensive dental infection should be cleared up in the presence of neoplasms of the intestine as one measure of preoperative care.

A point of interest to the dentist might be added here in answer to the question of loss of normal gastric acidity with the insertion of artificial dentures.

W. C. Alvarez said:

I cannot remember ever having seen any statistical data which would indicate that patients who lose their teeth lose the gastric juice. It would take several years to obtain such information, granted a desire to attack the problem. Then the researcher would have to be very careful not to be deceived since people commonly begin to wear dentures in the fifties, and about that time a percentage are losing their gastric juice just as they are losing their hair. Dr. Vanzant and I found that the percentage of people with harmless achlorhydria rises in a straight line from about 4 per cent at the age of 20 to about 23 per cent at the age of 65. These figures are approximate and from memory.

F. A. Willius, cardiologist, stated:

Regarding the question of dental sepsis and disease of the heart, I can, I believe, safely state that, in our present concept, this problem virtually narrows itself down to subacute bacterial endocarditis. This is a strange infectious disease, which, to our knowledge, never attacks the normal heart. The ideal set of circumstances for its development is a heart that has been only slightly injured; that is, either the valves or some portion of the endocardium, notably by a previous rheumatic endocarditis, a congenital lesion, an arteriosclerotic lesion or a syphilitic defect. The latter two are rather unusual. For this slightly injured area, *Streptococcus viridans* appears to have a special affinity. It is soon able to attract blood platelets from the blood stream and, with a great increase in their number, forms the primary vegetation, which continues to grow and to constantly dispatch minute particles consisting of pure bacteria or bacteria intermixed with blood platelets and fibrins. There are now numerous instances in the literature wherein subacute bacterial endocarditis has followed the extraction of an infected tooth. It, of course, becomes theoretically possible that an infected tooth, if allowed to remain undisturbed, may act in a similar manner, but convincing evidence to this effect is difficult to obtain. It is, however, without doubt a possibility. So far as the other forms of heart disease are concerned, no tangible evidence exists at this time clinically linking dental infection with cardiac disease.

C. H. Watkins, of the Section on Clinical Hematology, said:

So far as focal infection is concerned, in rare instances, removal of a definite focus will, I think, result in improvement in certain types of anemia which are resistant to treatment. We have seen this occur in an occasional case. However, I do not believe that one should place too much stress on this until all other causes of resistant anemia have been thoroughly investigated. In certain cases of hemorrhagic purpura following splenectomy, there may be episodes of a mild degree of hemorrhage from time to time, and, in this type of case, elimination of focal infection has proved of definite value. It seems to me that the most important thing is a thorough understanding of the blood conditions which usually have their initial manifestations in the mucous membrane of the mouth. This would permit an early diagnosis and, in many instances, a great deal of improvement may be obtained.[2]

Dental infection is of considerable interest to the ophthalmologist. W. L. Benedict said:

It is often difficult to demonstrate that infections about teeth are responsible for any individual case of eye disease. Extraction of affected teeth does not always have beneficial results; but it should be remembered, in this connection, that possibly all sources of organisms responsible for the eye affection were not eradicated with the extraction of the teeth, that organs other than the eye have been invaded and become secondary foci for the production of the same strain of organism, or that, even after extraction, a septic pocket may have remained in the diseased jawbone. Recurrent iritis, keratitis, uveitis and transient disturbances of ocular motility occur from these secondary foci after the removal of infected teeth and are to be combated by the use of autogenous vaccines.

Some forms of eye disease that formerly were believed to be due to autotoxemia, injury, blood disease or rheumatism or were idiopathic have been demonstrated to be due to the actual presence of bacteria carried to the eye from suppurative foci about the teeth or tonsils.

The barrier that Nature erects in defense of the eye may be effective against a specific strain of organism, and since organisms about the teeth multiply in kind as well as in number, the fact that an eye becomes diseased in a person whose mouth has been the harbor of pus-producing foci for years indicates that this barrier has been broken down, that his resistance has been lowered; or it may mean that a new organism has been introduced against which no barrier has been erected.

Attacks of eye disease from dental sepsis may be of any degree of severity. Mild attacks of conjunctivitis or iritis may occur which amount to no more than a transient hyperemia of the conjunctiva or a slightly troublesome photophobia. A rapid succession of mild attacks extending over a period of several years has been demonstrated to be due to periapical infection. The iris and choroid are more often attacked by organisms from apical infection, although optic neuritis, scleritis, keratitis and conjunctivitis are reported to have been found.

Much study has been given the relationship of dental sepsis and arthritis. I understand that no relationship exists with some types.

C. H. Slocumb, of the Section on Rheumatic Diseases, said:

Nonspecific infectious (rheumatoid, atrophic, proliferative) arthritis has no known specific organism which is invariably its cause, but it is generally regarded as due to an infection probably streptococcal in origin. Removal of infected foci has the four following reactions: 1. Usually, there is no apparent effect on the course of the disease. 2. Not uncommonly, there is a period of a few days following removal of foci when there is definite improvement in the symptoms of infectious arthritis. However, within a few days, the symptoms return, as severe as they were before operation. This effect has been observed after the administration of an anesthetic, even though no surgical procedure was performed (an experiment). 3. A few patients note improvement, which is retained after focal removal. 4. A flare-up in the chronic infectious arthritis seldom follows removal of foci if the general condition warrants the surgical procedure and if the focus is not in an acute stage of inflammation.

Removal of infected foci, including infected teeth, is justified in all patients with

infectious arthritis, and if the infectious arthritis is difficult to control, the removal of questionable foci such as devitalized teeth and dental roots should be advised. In a disease that may cause such crippling damage to joints and be so difficult to control as chronic infectious arthritis, it is advisable to give the affected patients the chance of improvement following focal removal and, even more important, to remove the pockets of infection so that the patient can be placed in the best possible condition to help nature combat the disease.

For patients with acute rheumatic fever, any surgical procedure may be followed by a flare-up in the rheumatic fever. Infected foci are not removed during the acute (exudative) stage of rheumatic fever and, when possible, their removal is delayed until after complete recovery from the attack of rheumatic fever. If, however, the disease becomes chronic (proliferative phase), obviously infected foci may be cautiously removed. The foci most often regarded as "triggers" that start an attack of rheumatic fever are infective areas in the upper part of the respiratory tract and throat, especially infected tonsils. Dental infection apparently has little to do with rheumatic fever, and dental surgical measures should be carried out conservatively.

In gouty arthritis, conservative removal of foci is advised. Intercurrent infections are known to alter the tolerance for purine derivatives. Removal of definitely infected foci may make gout easier to control. An acute attack of gouty arthritis may develop a few hours or days after operation. Careful control of the gout by means of purine restrictions in the diet and employment of a uric acid diuretic, for at least five days before and five days after operation, will usually save the patient the painful experience of an acute postoperative attack of gouty arthritis.

Many patients with skin diseases suffer marked reactions from removal or disturbances of foci. Paul A. O'Leary, of the Section on Dermatology and Syphilology, said:

Focal infection does not play a prominent part in dermatology, although there are a few diseases in which dental foci, the tonsils or the genito-urinary tract do play a very prominent part in the disease. These cutaneous disorders, which are, in the main, of an inflammatory nature, consist of erythema multiforme, erythema nodosum, chronic infectious dermatitis and certain of the bacterial infections of the hand and feet, to which the term "bacterids" has been applied. In addition to those already mentioned, there are a few other diseases in which foci seem to play a secondary rôle, such as psoriasis with arthritis, lupus erythematosus, urticaria and acne rosacea. From our experience in the removal of foci in cases of diseases of the skin in which infectious foci are significant, it is necessary, I believe, to stress the fact that these foci should be removed only after the cutaneous disease has subsided. It has been my experience that removal of these foci will cause more serious flare-ups than take place in cases of arthritis.

Another significant point in regard to focal infection as it applies to our particular field of medicine is the importance of removing infected teeth as well as cleaning up the mouth and removing poor and extensive crowns in cases of syphilis. The presence of infection, pyorrhea and a tremendous amount of metal in the mouth is a factor in various degrees of salivation from mercury as well as deposits of bismuth following intramuscular injection of bismuth preparations. Accordingly, it is our practice, before starting treatment to have these foci treated locally when possible, and, if they are unresponsive to treatment, to have them removed.

G. J. Thompson said:

The relationship of infections in the genito-urinary tract to focal infection elsewhere in the body, particularly infected teeth, is definite. On several occasions, I have seen acute prostatitis, pyelonephritis, acute cystitis, etc., develop subsequently to the extraction of the infected tooth. Such infections seem an acute manifestation of a previously existing chronic infection, and the acute flare-up is undoubtedly evidence of the relationship. Chronic infections in the prostate, bladder and kidney will often not respond to therapy until dental foci have been eliminated. The relationship of dental sepsis in other urologic conditions,

aside from infectious processes, does not appear so definite. However, renal hematuria of the essential type occasionally stops after extraction of devitalized or infected teeth. Unfortunately, many urologists either are not familiar with these facts or are loath to believe the important part that dental sepsis certainly plays in urologic conditions. Any effort that dentists make to call these facts to the attention of the general practitioner and to the urologist is very worth while.

**E. C. Rosenow, of the Division of Experimental Bacteriology, in a brief summary of his present ideas, said:**

Dental foci of infection, even though symptomless, are a common cause of systemic disease beyond question of a doubt; but the need for further consideration of this important problem is still at hand.

The underlying principles of the conception are not yet sufficiently understood or applied. Dental and other foci of infection are still not always considered and, inadvertently or otherwise, are allowed to remain in diseases in which clinical and experimental proof of their importance has been adduced, but are often eliminated in patients suffering from diseases not attributable to such foci. A history of acute symptoms referable to foci is too often considered essential to indicate causal relationship of dental and other foci of infection to systemic disease.

The prevention of exacerbations of symptoms of systemic disease following removal of even symptomless dental foci is still largely an unsolved problem. This is true as regards technical procedure and stage and nature of the diseases in question.

Without going into detail in summing up my views of the problem at this time, I can do no better than quote the following statement made in 1919: "A sane and comprehensive effort toward the prevention and cure of septic foci in the dental and other areas will result in the alleviation of human suffering, in a better preservation of the tissues in old age, in a longer average duration of life, in increased mental and physical efficiency, in the prevention and cure of acute and chronic disease, and, through the laws of heredity, make for a sturdier race."

In the Section on Dental Surgery, a conservative attitude toward dental infection and its relationship to systemic disease is maintained. We classify pulpless teeth into two groups: Group 1 includes those teeth that are grossly involved both roentgenographically and clinically, those that would be eliminated from a strictly dental point of view. Group 2 includes those teeth that are pulpless, but otherwise roentgenographically normal, and teeth that are well restored, comfortable and serving their useful purpose.

We recommend to the patient's examining physician that teeth in Group 2 be removed in addition to those in Group 1, if the patient's physical condition is such that all suspected foci should be eliminated.

The supporting structures are carefully examined and treatment is recommended according to the patient's needs. Patients are informed that further extraction of teeth may be advised by their local dentist in order to facilitate satisfactory restorations.

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# SURGICAL TREATMENT OF MANDIBULAR DEFORMATIONS

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THE usual malformations of the mandible and maxillae resulting in occlusal discrepancies are primarily an orthodontic problem. The recent progress of orthodontia has made it possible to treat successfully nearly all of these cases provided they are recognized early and receive proper attention. Early recognition of maxillomandibular deformations is necessary to non-surgical correction, and the old axiom "an ounce of prevention is worth a pound of cure" is certainly applicable during development of the mandible. Certain cases, however, are not recognized early or are not referred to the orthodontist until the conditions are so advanced that treatment by orthodontia alone is extremely difficult or impossible. In these instances, it is necessary for the orthodontist to seek the aid of the oral surgeon, not only because of the occlusal deformity, but also because of the distorted facial appearance, important factors in the psychologic reactions of the patient. In cases of gross deformity of the jaws with marked discrepancies in occlusion, no qualified orthodontist would assume the sole responsibility of correcting the deformity. By the same token, no plastic or oral surgeon would attempt to correct these cases without assistance.

## HISTORICAL DATA

The indication for surgical interference was early recognized, but no operation was described in the literature until 1848, at which time Hullihen[1] performed an operation for mandibular prognathism using partial osteoplastic resection of the mandible in the region of the cuspids. He removed a wedge-shaped section of bone with the base directed upward, the lower border of the mandible being left intact. Although improvement in the occlusion resulted, the length of the mandible was unaltered and the appearance of the patient was unchanged. Fifty years later, Blair[2] removed wedge-shaped sections of bone of the entire thickness of the mandible in a case of prognathism. He attempted immobilization of the fragments by direct wiring, but found this unsatisfactory, and so substituted orthodontic bands and traction screws, with good results. In 1903, the late Dr. Angle[3] condemned orthodontic treatment for pronounced prognathism, stating that the orthodontist must recognize the limitations of orthodontic treatment. He said, "No operation dependent on tooth movement could establish proper relation of the teeth or materially improve the facial lines in certain cases of pronounced overdevelopment of the mandible, and it is in such cases that surgical interference is indicated."

Blair[4] published in 1907 the results of a comprehensive study of malrelation between the maxillae and mandible. He advocated mandibular resection in the bicuspid region. When the body of the jaw was relatively retracted, he advocated division of the vertical ramus

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where the nerve enters the canal. The line of division was directed downward and forward in order to lengthen the ramus. The saw was introduced by means of a large curved needle after exposure surgically of the posterior border of the ramus. In patients with open bite, he recommended either the removal of v-shaped sections of bone at the point of deviation or a curved incision without removal of bone so that the anterior fragment could be elevated by a slight rotation of the bone. Two years later, Babcock[5] advocated the transverse division of the rami either by intra-oral or by external incision in prognathism. The chin was displaced upward and backward, a v-shaped opening remaining between the fragments of the rami, in which he placed magnesium or ivory spools. Later, Lane[6] advocated the division of the body of the rami transversely just above the level of the inferior dental foramen, allowing the body of the jaw to slide back. He used metal plates to fasten the fragments in their new position.

Aller,[7] in 1917, operated upon a patient by the intra-oral route and removed v-shaped sections in the region of the second bicuspids immediately after extraction of the teeth. Great care was taken not to cut through the skin, and after failure in the application of dental splints, intermaxillary wiring was resorted to.

Kostecka,[8] in 1931, recommended surgical treatment rather than conservative orthodontic measures in the problem

Fig. 1 (Case 1).—Right profile view prior to reconstruction. The nose has a marked hump and is too long. The upper lip is too short from columella to vermilion border. The upper anterior teeth and alveolar process protrude one-half inch beyond normal, wide separation of the lips resulting. The lower jaw is underdeveloped and recedes three-fourths inch.

Fig. 2 (Case 1).—Results of surgical reconstruction. The pleasing expression is the result of harmonious blending of the facial characteristics, accomplished by tissue remolding, reduction and reconstruction.

of open bite. In these cases, as well as anomalies of the Angle Class II variety, he utilized osteotomy of the ascending rami. In discussing Kostecka's paper, Pichler warns of the possibility of facial nerve injury, at the same time stating that neither he nor the author had encountered any such accidents.

Calvin S. Case,[9] in his textbook on "Dental Orthopedia," described a few Class III cases which he successfully treated by removal of certain teeth followed by extensive orthodontic treatment.

Fig. 3 (Case 2).—Underdeveloped symphysis and short mandible; "round" profile.

Fig. 4 (Case 2).—Result of reconstructive operation. The chin tissues have been elevated 18 mm. by three "on end" sections of eighth rib cartilage. This view is to be compared with Figure 3 to emphasize the improvement in the profile appearance.

## CLASSIFICATION

The great variety of deformities encountered in the upper and lower jaws renders thorough classification extremely difficult. We have evolved the following classification, which covers in a general way the major and minor deformities of the upper and lower jaws.

I. Malocclusion of the teeth with normal size and relation of upper and lower jaws.

II. Retrusion of the mandible.

(a) Underdeveloped body and symphysis of mandible, with teeth in abnormal occlusion and abnormal profile; usually bilateral, but may be unilateral.

(b) Underdeveloped symphysis of mandible with teeth in acceptable occlusion, but abnormal profile; usually bilateral, but may be unilateral.

III. Protrusion or prognathism of mandible.

(a) Body of mandible and lower arch in mesial relation to upper arch and maxillae; usually bilateral; Angle Class III.

(1) Elongated body of mandible with opening of angle of ramus.

(2) Overgrowth of body and symphysis with normal angle.

IV. Open bite deformations.

(a) Mandibular deformity anterior to mental foramen.

(b) Upper jaw deformity due to abnormal development causing malocclusion.

(c) Maldevelopment of both upper and lower jaws.

(d) Mandibular curvature. (Federspiel.)

(1) Increased angulation of lower jaw

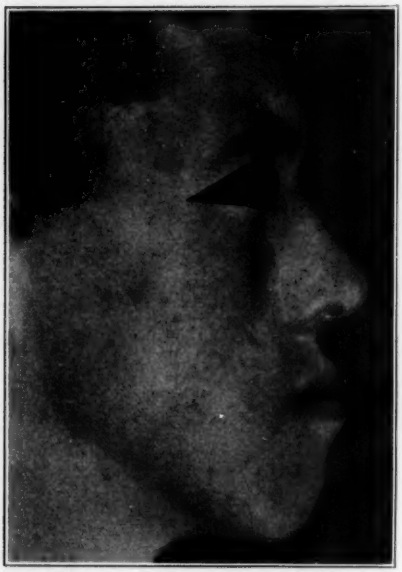

Fig. 5 (Case 3).—Overdeveloped and protruded lower jaw; protrusion on left side of 13 mm.; right side, 15 mm. The enlarged lower lip and abnormal profile are to be noted.

with upward curvature in region of molar teeth (may be placed in Angle's classification I, II or III.)

V. Deformed superior maxillary arch.

(a) Secondary deformities caused by cleft palate.

(b) Protrusion of anterior alveolar ridge.

VI. Deformities of the jaws or alveolar arches caused by injury or from destruction by disease process.

## TREATMENT

We are concerned here with only those patients who require surgical measures for correction. We consider the preoperative management most important and in practice utilize models, x-rays and photographs routinely. Models are made from impressions of the upper and lower arches, which are mounted on an articulator. The upper model is securely attached to the upper bow, and the lower model is slotted on the lower surface to fit a slide attachment on the lower bow of the articulator so that it can be moved anteroposteriorly. Lateral and anterior-posterior life-size x-ray plates, as well as 8 by 10 right and left profiles and front view photographs, are made. Profile drawings are made to determine the extent of tissue reconstruction. Measurements are taken and profile templates constructed for use during the surgical procedure.

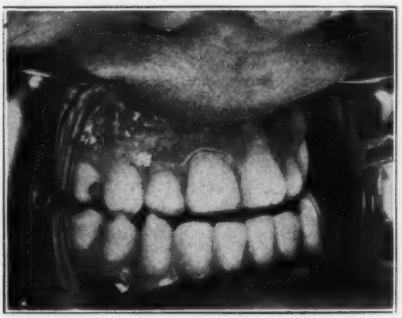

Fig. 6 (Case 3).—Malocclusion of teeth. The lower jaw protrudes 15 mm.

## SURGICAL METHODS

*Bilateral Retrusion of Mandible.*—This type of deformity is comparatively rare. It may be of congenital origin or may be due to trauma and infection. Retrusion of the jaw may be accompanied by a temporomandibular ankylosis. The first

operation, when ankylosis is present, consists of dividing the bone in the region of the temporomaxillary joint and the interposition of *fascia lata* grafts. The second operation elongates the body of the mandible. The L-shaped division is used to divide the bone on both sides, as recommended by Kazanjian.[10] A vertical cut is made through the bone in the region of the second bicuspid or first molar tooth (one or both teeth must be removed) to a point below the inferior dental canal, then extended horizontally backward through the ascending ramus. The loosened anterior fragment is then brought forward to normal relation with the upper jaw and held in place by special splints and intermaxillary wiring. If this surgical procedure does not restore the symphysis to a normal profile, a cartilage graft is implanted.

Fig. 7 (Case 3).—Normal occlusion and intermaxillary relation. In this case, it was not necessary to grind a single cusp; which is unusual.

*Underdeveloped Symphysis.*—The body of the mandible may be fully developed and the teeth in normal or acceptable occlusion, but the symphysis be underdeveloped, this causing a recession of the chin and an abnormal profile. We have operated in a number of such cases by inserting rib cartilage. A 3-cm. curved incision is made beneath the symphysis, and the chin tissues are separated from the bone. The soft tissues are then brought forward and held by a carefully prepared three-section cartilage graft. The cartilage is divided into two short lateral sections and one long central section. The three pieces are held together with plain catgut. One end is carved to a concave outline to conform to the convex surface of the symphysis. The outer end is carved to a convex outline to give normal contour to the tissues covering the chin.

*Mandibular Prognathism.*—Two types of operations may be employed with good results: (1) bilateral resection of the body of the mandible and (2) horizontal division of the ascending rami.

Fig. 8 (Case 3).—Appearance of patient after completion of operation; showing normal profile. (Compare Figure 5.)

Resection of the body of the mandible: After careful preoperative study and determination of the position of the lower jaw by means of the bite, the desired postoperative intermaxillary relation must be accurately determined. This is best done by removal of sections from each side of the lower model. If this

is accurately done, the width and shape of the bone sections to be removed can be determined. The shape and size depends on the deformity to be corrected; i.e., the section on one side may be wider than on the other side to correct lateral deviation and protrusion. If "open bite" and protrusion are to be corrected, the sections must be accurately planned. Metal templates are made from measurement findings, for use at the time of operation. If the sections removed are too wide, there will be a lack of bone fragment approximation, which may result in fibrous union. If the bone sections are too narrow, the desired intermaxillary and occlusal relations are not secured.

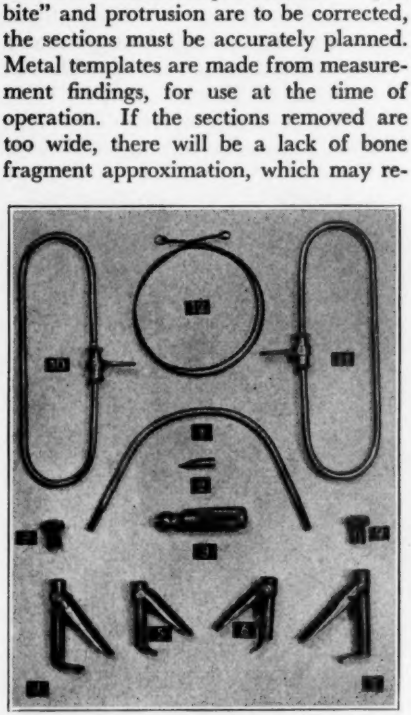

Fig. 9.—Authors' surgical instruments for osteotomy of the rami. 1, curved steel slotted cannula. 2, beveled and pointed tip. 3, handle. 4 and 5, slotted and winged collapsible guards, right side. 6 and 7, slotted and winged collapsible guards, left side. 8 and 9, threaded and slotted lock nuts. 10 and 11, handles for saw. 12, Gigli saw.

There are two methods for bone section removal; namely, transmucoperiosteal and submucoperiosteal. The location for the section removal is in the region of the first molar and second bicuspid teeth. If the transmucoperiosteal method is used, the first molar and second bicuspid teeth are removed at the time of bone sectioning. The lower border of the mandible is exposed through an incision 3 cm. in length, beneath the second bicuspid and first molar teeth. The tissues are carefully separated from the periosteum and the mucous fold is punctured. The bone sections are removed with a straight nasal saw. The moment the oral cavity is entered, an infected wound is created. The fragments are approximated, and the wound is closed and a drain inserted.

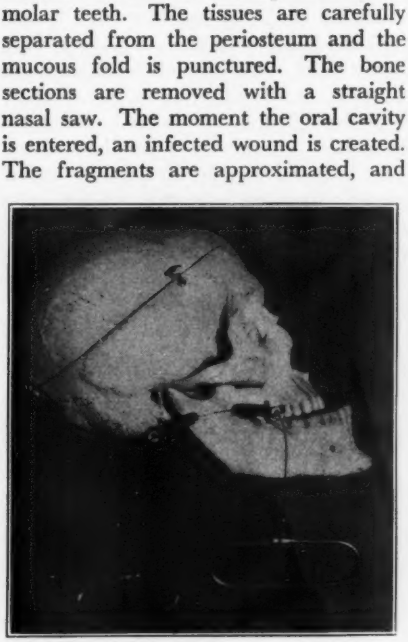

Fig. 10.—Use of instruments shown in Figure 9. The saw is on the lateral surface of the ramus after osteotomy.

By the submucoperiosteal method, the first molar and second bicuspid teeth are extracted at least three months prior to operation to allow regeneration of the mucoperiosteum over the sockets. Through a 3-cm. incision along the lower border of the mandible, the periosteum and mucoperiosteum are separated from the bone and the alveolar process. To prevent contamination, the bone sections must be removed without entering the oral cavity. We have found this extremely difficult because of the thinness

and inelasticity of the tissues covering the alveolar ridge. While we would not say that it is impossible, we do believe that its accomplishment is highly improbable. In other words, in most cases, with either method, wounds become infected and must be treated as a compound fracture. We do not believe that the removal of the first molars allows adequate space for bone section removal. If even moderate prognathism exists, the close proximity of the saw to the roots of the second molar and second bicuspid teeth may cause such postoperative complications as infection, osteomyelitis and loss of adjacent teeth. In extreme prognathism, it is imperative that both teeth be sacrificed. Advantages of resection of the body of the mandible are as follows:

Fig. 11.—Anteroposterior osteotomy of the rami completed. The protruded mandible shown in Figure 10 has been carried backward to establish a normal intermaxillary relation.

1. The operation is less hazardous.

2. The possibility of facial paralysis or a salivary fistula is eliminated.

3. Extensive "open bite" and prognathism can be corrected in the same operation.

4. In operations to correct prognathism, a wide arch can be narrowed at the same time.

The disadvantages are as follows:

1. The bone is divided four times instead of twice.

2. Bilateral mandibular fractures result, with possible difficulty in bone regeneration due to infection.

3. There is a possibility of extensive osteomyelitis.

4. The procedure requires removal of either two or four teeth, with possible injury to the roots of the adjacent teeth.

5. It may be difficult to control the anterior fragments from downward and backward displacements owing to the action of the hyoid group of muscles.

Fig. 12 (Case 4).—Extreme prognathism. The lower jaw was 3 cm. in protrusion. The patient had been advised for years that nothing could be done to correct the condition.

6. Direct wiring may augment the infection, with probable loss of bone by sequestration, and thus make impossible the desired bone alinement and occlusion.

7. The drains must be inserted through the skin incisions.

8. Noticeable scars usually result from resorption or infection.

9. Severance of the inferior dental

artery and nerve creates anesthesia in the tissues comprising the anterior fragment for several months, sometimes accompanied by drooling.

10. There is a shortening of the lower arch, which reduces the space for the tongue.

11. At least four intermaxillary wires are necessary for secure immobilization.

*Osteotomy of the Ascending Rami.*—We believe that this method has not been used more often because of the hazard incident to the area for operation and lack of accurate surgical technic. Various instruments have been used to divide the ascending rami, such as surgical burs, the Gigli saw, straight saw and chisels. Our operative experience in these cases has impelled us to make an exhaustive study of the object. We have utilized several methods and have designed instruments, many of which have failed of their purpose. We now present a definite surgical procedure and technic for rami osteotomy. We have also designed instruments and evolved a surgical technic for the resection of parallel-epipedonal sections from that region of the sigmoid notch and transposition of the condyle as shown in Figures 14 and 15.

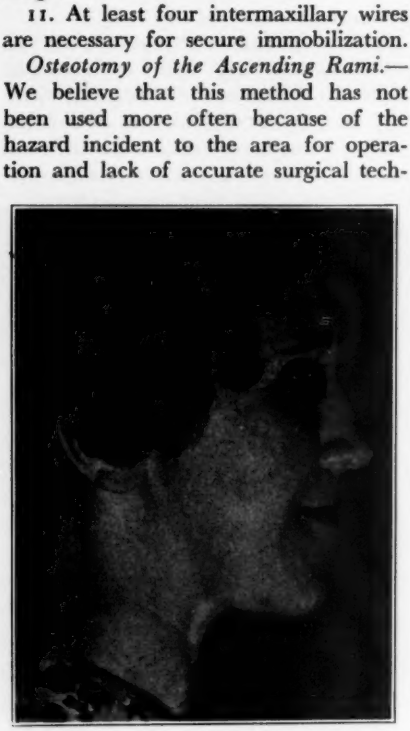

Fig. 13 (Case 4).—Result of reconstructive measures; showing normal profile. (Compare with Figure 12.)

The advantages of horizontal osteotomy of rami over bone section excision are as follows:

1. If the operation is skilfully done, the inferior dental nerves and arteries are preserved.

2. No teeth are sacrificed, nor is there any injury to the roots of the adjacent teeth.

3. There is no postoperative anesthesia or hemorrhage.

4. There is no anterior-posterior shortening of the lower arch.

5. There is no postoperative infection or loss of bone due to oral contamination or the insertion of wires.

6. No drains are necessary, and the small incision leaves no noticeable scar.

7. The orthodontist can secure better results because no teeth have been removed from the lower arch.

8. Only two intermaxillary wires are necessary for immobilization. (Figs. 1 and 2.)

nic. The close proximity of the cervicofacial nerve, the parotid gland, Stenson's duct and the inferior dental artery and nerve demands an exacting technic, to avoid such complications as facial paralysis, profuse hemorrhage, external salivary fistula or an infection due to puncturing the oral mucosa.

The location of the operative field has made bone division with preservation of the adjoining tissues extremely difficult.

### SURGICAL CORRECTION OF OPEN BITE

Which part of the mandible is to be attacked surgically depends on the deformity causing the malocclusion. After the mandibular deformity and the intermaxillary relation have been determined, the most applicable surgical approach is selected. Moderate "open bite" with-

out excessive protrusion in a child under 15 years may, in some instances, be corrected by the orthodontist. After the age of 15, even moderate "open bite" is rarely treated successfully by orthodontia. Probably the most difficult type of malocclusion which the orthodontist is called upon to combat is "open bite." In these cases, not only the alveolar process is involved, but also the apical base, especially the symphysis, body, angle and ramus. This fact definitely places this type of malocclusion and mandibular deformity in the field of surgery.

*Site of Operation.*—1. If moderate "open bite" exists, the first tooth on each side which is out of occlusion is removed and the mandible divided. The anterior fragment is then pushed upward into occlusion.

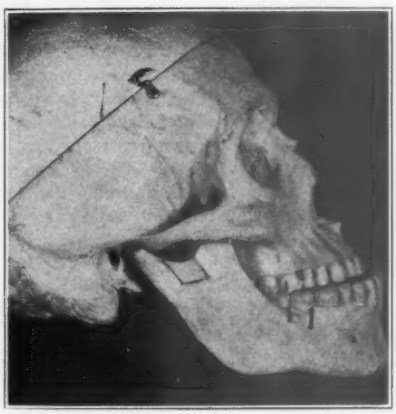

Fig. 14.—Authors' new method of removing parallelepipedonal bone section from region of sigmoid notch.

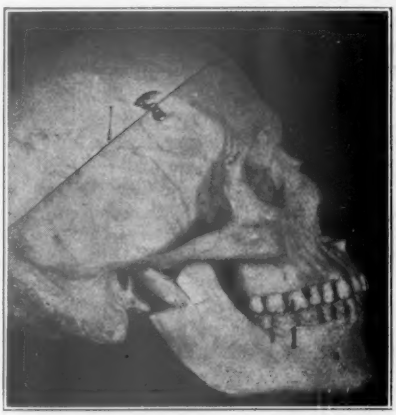

Fig. 15.—Protruded lower jaw carried backward to approximate coronoid process and condyle. (Research is being continued by this method and the technical data will be published later.)

2. In more marked cases, the first molars or second bicuspid teeth are extracted and v-shaped bone sections are removed. The bone fragments are accurately approximated and the anterior fragment is pushed upward and wired to occlusion with the upper teeth.

3. In complicated cases, the posterior portion of the ascending ramus is divided by vertical osteotomy. The lower teeth are brought into occlusion with the upper teeth and securely held by intermaxillary wiring.

4. If the deformity is complicated by both "open bite" and prognathism without extreme upward curvature of the mandible in the molar region, one operation will suffice. Operation consists of anterior-posterior osteotomy of the ascending rami just above the inferior dental nerve and artery.

5. A more complicated case consists of prognathism and "open bite," with increased angulation and extreme upward curvature of the body of the mandible in the molar region. Such a case may require two surgical operations for ideal results because the anterior or posterior convexity of the occlusal plane of the lower teeth may make impossible the necessary intermaxillary occlusion by anterior-posterior rami osteotomy alone.

Therefore, in addition to osteotomy of the rami, the v-shaped bone sections are removed from the body of the mandible, in order to eliminate the upward curvature of the mandibular body in the molar region and to elevate the anterior por-

tion to establish normal downward curvature of the occlusal plane of the lower arch.

### REPORT OF CASES

CASE 1.—M. R., aged 27, a dancing instructress, complained of retrusion of the lower jaw, with increased prominence of the upper jaw and also the nose, which, she felt, distorted her face considerably and which caused her a great deal of mental anguish. There was no complaint of difficulty in mastication. The patient was interested in having the deformity corrected for facial symmetry rather than because of any functional abnormality.

Examination of the oral cavity revealed that the occlusion of the molars and bicuspids was unsatisfactory. The upper arch was narrowed, with a high palatal vault, increased anterior-posterior length and excessive protrusion.

Profile examination revealed excessive protrusion and narrowing and wide separation of the lips with exposure of the central and lateral incisors. The nose was too long and had a hump. The chin receded owing to underdevelopment of the symphysis. The following reconstructive plastic and oral operations were performed.

1. The upper central and lateral incisors were removed. The protruding alveolar process was removed to the extent of 1 cm.

2. Corrective rhinoplasty, consisting of removal of the "nasal hump," shortening of the septum, widening of the upper lip and general reduction in size of the nose, was performed.

3. The eighth rib cartilage was removed for use in correcting the receding chin and to compensate for the underdeveloped symphysis. A 2-cm. incision was made beneath the chin. The tissues were loosened over the anterior surface of the mandible between the mental foramina. The cartilage was divided into three sections, properly carved and placed over the symphysis. The soft tissues were elevated 2 cm.

4. Several weeks later, the profile was studied, and it was found that the chin was 0.5 cm. posterior to a normal profile. This was corrected by transplanting a section of de-epithelized skin and fat from the abdominal wall.

5. An esthetic dental appliance which restored incisor occlusion was made by the dentist, B. M. Tylicki, of Long Beach, Calif.

The following was accomplished in this case: (1) an improvement in occlusion; (2) a normal profile, and (3) a happy state of mind, due to the improvement in appearance. (Figs. 1 and 2.)

CASE 2.—E. A., a girl, aged 16, complained of retrusion of the lower jaw, which she first noticed at the age of 12 years. Since that time, the deformity had become increasingly noticeable, causing her a great deal of mental anguish and resulting in a marked inferiority complex. She had been under the care of an orthodontist between the ages of 9 and 15 years to correct malocclusion.

Examination revealed that the teeth were in good occlusion, but the body of the mandible was in bilateral retrusion, the position of the symphysis being about 20 mm. posterior to normal. The distance from the angle to the symphysis was less than normal.

Operation consisted of transplantation of rib cartilage, which was inserted through a small incision beneath the chin and immobilized on the anterior aspect of the symphysis. Recovery was uneventful. (Figs. 3 and 4.)

CASE 3.—D. McK., a boy, aged 17, complained of protrusion of the lower jaw, which was first noticed at the age of 9, by his mother. Although he was under the care of an orthodontist for some time, the results naturally were unsatisfactory, as treatment of this condition, in which there is an excessive and persistent mandibular deformity, is beyond the field of orthodontia. The deformity had become more marked since that time, causing the patient to become introverted mentally.

Examination revealed an extreme overdevelopment of the lower jaw, with protrusion and malocclusion. The lingual cusps of the lower molars occluded with the buccal cusps of the upper molars, and the lower incisors were situated 16 mm. anterior to the upper incisors. On the left side, the teeth were more nearly in occlusion than those on the right. The lower arch was larger than the upper arch.

After photographs and x-ray pictures were taken, models were made and mounted on the articulator. Sections were removed from

the models to determine what bone was to be removed. Metal templates were then made. Three months prior to operation, the second bicuspids and first molars were removed on both sides. Operation consisted of resection of the body of the mandible. The section of bone removed from the right side was 2 mm. longer than that on the left, owing to the difference in preoperative occlusion.

Intermaxillary wiring as well as direct wiring was used for immobilization. The direct wiring was removed in two weeks and the intermaxillary wiring in eight weeks. Recovery was uneventful. (Figs. 5, 6, 7 and 8.)

CASE 4.—E. H., a woman, aged 38, complained of protrusion of the lower jaw, which was first noticed at the age of 12. For several years, the protrusion progressed, but, for the past ten years, she had noticed little change. She stated that it was impossible to masticate her food. She had not received orthodontic treatment.

Examination revealed marked protrusion of the mandible, the lower incisors being located 18 mm. anterior to the upper incisors. The tip of the chin was located outside a line drawn from the forehead through the tip of the nose. On the right side, the only point of contact was between the lingual surface of the lower second molar and the buccal surface of the upper second bicuspid and first molar.

Operation consisted of bilateral osteotomy of the ascending ramus midway between the sigmoid notch and the mandibular foramen. Immobilization was obtained by the use of intermaxillary wiring for eight weeks. When union was sufficient, the symphysis was reduced by removing 1 cm. of bone from the anterior border. Recovery was uneventful. (Figs. 12 and 13.)

## SURGICAL INSTRUMENTS AND SURGICAL TECHNIC FOR OSTEOTOMY OF THE RAMI

The ideal technic accomplishes the proper angle division of the ascending rami at the desired location without injury to nerves, blood vessels or the parotid gland.

Figure 9 shows the instruments which we have designed. The preoperative study and diagnosis of the case to be operated upon having been completed, the patient is hospitalized. Deep block anesthesia is utilized in most cases. The position of the temporomandibular joint, posterior border of the ramus, lower border of the zygoma and Stenson's duct are then outlined with a dermatographic pencil.

A perpendicular 2.5 cm. incision is made through the skin over and below the neck of the condyle and over the posterior border of the ascending ramus. With closed blunt scissors, the tissues are carefully separated and the cervicofacial branch of the facial nerve and parotid gland are pushed posteriorly. One centimeter of the posterior border of the ramus below the neck of the condyle is then exposed. The position is checked by passing a small curved instrument into the sigmoid notch. The short handle (3) (Fig. 9) is screwed to the end of the curved slotted cannula (1). The beveled tip (2) is screwed to the cannula (1). The tip (2) enters the skin at a point 1 cm. anterior to the base of the coronoid process. The index finger of the left hand palpates the oral tissues lining the cheek and below the coronoid process and guides the beveled cannular tip around the bone without puncturing the oral tissues. In a circular fashion, the tip is pushed backward above the inferior dental foramen in close proximity to the lingual surface of the bone, thus avoiding the inferior dental nerve and artery. The pointed tip is advanced around the posterior border of the ramus and over a concave director, which protects the facial nerve and parotid gland. The tip and handle are then removed.

The collapsible guards (4 and 5) are placed over the ends of the curved cannula (1) and fitted against the anterior and posterior borders of the ramus. The grooved cannula is rigidly held against the lingual side of the ramus just above the inferior dental foramen at the correct anteroposterior angulation. The collapsible guards, which are equipped with a

sharp projection on each side of the slot, are securely held against the ramus by lock nuts (8 and 9).

The Gigli saw (12) is passed along the groove of the curved cannula (1) around the ramus, the handles (10 and 11) are attached and the bone is divided. The collapsible wings or guards (4 and 5) open as the saw divides the bone, this preventing injury to the vital soft tissues. The same procedure is repeated on the opposite side with the other collapsible guards (6 and 7). The loosened mandible is pushed backward to the desired occlusal position and the intermaxillary wires are inserted. This technic makes division of the rami an accurate surgical procedure. Osteotomy of the rami is accomplished at the desired degree of anteroposterior angulation with minimum injury to the surrounding tissues. (Figs. 10 and 11).

## CONCLUSION

In this paper, it was possible to discuss only briefly certain types of deformities of the jaws. Disease, trauma or the maldevelopment of the tissues may cause maxillofacial alterations ranging from the most simple one to a gross deformity. The deformity may prevent normal speech and normal masticatory function, which may involve the respiratory and gastro-intestinal systems. The detraction from the personal appearance and the depressed mental state which accompany these abnormalities are in many cases very marked, and each and every case should be carefully studied and analyzed before treatment is advised. In order to render efficient service, there should be close cooperation between the plastic surgeon and the orthodontist. Reconstructive surgical measures combined with orthodontic procedures on patients past puberty make possible rapid correction of these defects and assure results not possible in either specialty separately.

We take pleasure in presenting a surgical technic for osteotomy of the rami based on a well-planned surgical procedure and which prevents injury to the vital structures at the site of operation.

The surgical technic illustrated in Figures 14 and 15 shows the authors' new method of removing a parallelepipedonal bone section from the region of the sigmoid notch. Research is being continued by this method and the technical data will be published later.

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# TOOTH PREPARATION IN ITS RELATION TO ORAL PHYSIOLOGY

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## NATURE'S CAREFUL PREPARATION

*Tooth Form.*—The care exercised by the healthy fetal human organism in preparing the teeth for the purpose of mastication excites the wonder and admiration of any student of biology. Astonishingly early in the second quarter in the life of the fetus, the shapes of all the teeth except the second and third molars are determined. The shapes of the latter are determined early in the life of the infant, of the second molars during the first year and of the third molars between the third and sixth year.

When man comprehends that the human teeth are prepared for adaptation to the many factors of articulation from five to six years before they are brought through the gums into use, he is overawed by the fact that the seeds of articulative coordination are sown so early in the life of the individual. Indeed, the mysteries of tooth development and tooth eruption are greater even than those of growing seeds, parts of which grown downward and other parts upward. How and why teeth take forms designed to be in complete accord with the forces which will use them years later for masticating food baffles the intellect into humility.

The growth and developmental processes of the infant organism in forming and arranging the teeth so that they are well housed during the development and yet are prepared to erupt in the proper skeletal positions are as great as those used by the embryonic tissues of a plant in developing a bud of a perfect flower. If the individual child is well born and kept healthy, the unfolding of the mouth is as orderly as the opening of a floral bud. In fact, the undeveloped state of the mouth might be compared to that of a bud, the well-arranged teeth being comparable to imbricated embryonic leaves.

*Structural Preparation.*—After the bud of the tooth is given off by the epithelium and connective tissue layers, the cells of the enamel organ take the shape of the future crown and then faithfully prepare the enamel to suitable hardness, and the dental papilla forms the foundation of the crown and begins constructing the type of root necessary to bear the stresses to which the tooth will be later subjected.

After eruption, the preparation of the periodontal membrane begins in earnest. The epithelium of the mouth quickly heals the tissue torn during eruption and keeps it confluent with the enamel, thus preparing a relationship of the tissues to resist the inroads of infection. The development of the alveolar process on the crest of the jaw bone is timed perfectly to make a mooring for the finished tooth when it comes into full physiologic contact with its neighbors and its opponents. No part of any animal or plant organism is more wonderful in its design or more mysterious in the foreordained relationship of its parts than the growth and development of the masticatory apparatus. One has only to comprehend the fact that the teeth are fully formed as to shape and size to match their opponents

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and their neighbors long before they are brought into use, to be overwhelmed with awe and admiration for the life processes involved. Even the eye, which biologists hold as one of the greatest evolutionary mysteries of life, takes second place in developmental mystery to the teeth.

*Immunity Preparation.*—Every living organism has some provision made to repair injuries. The story of the clotting of the blood, the reaction of the white blood cells to infection, the healing processes of the soft tissues and the bones is as intriguing as a fairy tale.

With all these wise provisions of Nature, apparently the teeth are wholly unprepared for caries or injury to their developmental processes. They seem to have no way of healing the injuries by redepositing the lost tissue or a substitute for it. Nature, for some unknown reason, made no provision for scar tissue healing of the teeth. All a tooth can do is to build inwardly layers of secondary dentin to enarmor the living pulp tissue.

To some extent at least, we are led to believe that the teeth are prepared to resist acid erosion at the gingiva by intensifying the density of the dentin, and there may be something to the assertion that teeth can be made resistant to carious processes, but aside from these reactions to unfavorable media, there apparently is no way whereby the tooth can fend off the attacks of caries and the decalcifying acid-loving bacteria, and we feel sure its powers of recovery are almost nil. If the tooth has internal immunity, we certainly do not know the mechanics of it or where the seat of this mechanism of immunity lies.

Cleanliness is the age-old theory and practice of the mechanism of tooth immunity. In healthy animals properly fed, the natural cleanliness of the teeth is noteworthy. They are free from calcareous deposits and seem to be easily and thoroughly cleansed by the tongue and cheeks after eating. If there is any natural immunity beyond the ability of the saliva to cleanse the teeth, we do not know what it is. This cleanliness may be both chemical and physical. Why the tooth should be the exception of living tissue in repairing itself is a fact we are compelled to accept without understanding.

## SCOPE OF DENTAL PREPARATION

*Scope of Dentistry.*—As we can see the natural preparation of the teeth for the purpose they perform, we, to a considerable extent, understand what the practice of dentistry should be. Dentistry must ever remain a handmaiden to natural processes. The dentist must know how the normal body behaves so that he can guide it back to proper reactions when it is diseased or abnormal. He cannot violate the natural processes: he must work with them. The understanding of the healing process of the periodontium together with an understanding of the lack of healing processes in the tooth makes it possible for him to predicate his plan of treatment on logical biologic lines. The acceptance of artificial restorations by the tooth is no less wonderful than the healing processes of the other tissues, especially the acceptance of entirely foreign substances such as metals. Dental preparation, for the purpose of discussion, may be outlined as follows: 1. Promoting self-cleansing of the teeth. 2. Arranging them in correct relations. 3. Keeping the gingivae confluent with the enamel. 4. Preparing the teeth for artificial restorations. 5. Preparing the teeth to accept appliances that restore lost teeth.

*Preparing the Teeth to Keep Clean.*—The fact that the mouth of a well-kept animal is strikingly clean emphasizes the importance of dental prophylaxis. When dentists believed more sincerely that the entire immunity of the teeth depended on their self-cleansing surfaces, there were advocates who practiced recontouring and highly polishing the surfaces of

them by using stones, strips, pumice, fine emery, tin oxide or other fine abrasives. They even carried the idea over into the practice of grinding to smoothness the occlusal surfaces of the molars and bicuspids, thus robbing them of their food seizing and cutting cleats. They even separated the teeth with stones, believing that approximal surfaces out of contact would not decay.

Dentists have practiced these ideas long enough to know now that such a concept is extreme, but they also know that rational prophylaxis is a necessary adjunct to hygienic care. Good daily cleaning on the part of the patient does reduce the extension of caries about prostheses, and we have good reason to believe that it prevents the beginning of carious processes and that it tends to keep the periodontium well. This we know in spite of the fact that we have all seen unkept, filthy mouths that do not show the reaction that we would expect.

*Arranging Teeth in Articulation.*—Teeth are dependent for articulation as much on their arrangement as on their shapes. Arrangement includes the formation of the dental arches, centric interdigitation of the cusps and the articulative cooperation of the cusps and, more explicitly, the vertical position of the teeth in the arches, the relation of the plane of occlusion in the face and the radius of the curve of Spee, which makes this cooperation of the cusps with the established temporomandibular articulative factors possible. When Nature fails in the preparation of this arrangement, orthodontists, in their diagnostic studies, should learn to what extent natural preparation has failed. Only by an understanding of what the natural relation should be can they hope to understand the anomalies of the natural preparation. Orthodontic treatment then becomes wholly a matter of preparing teeth for their best uses and appearance by repositioning and rearranging them according to the biologic plan. In that sense, all orthodontic effort is a kind of tooth preparation.

*Periodontic Preparation.*—Originally, periodontic work consisted largely of scaling the teeth. Later, it was devoted to the surfacing of the enamel and the exposed cementum, as was mentioned previously. It was and is primarily tooth preparation, a very essential part in the physiologic consideration of preparing the mouth. The theory of periodontics and its application is that a tooth so prepared will stay cleaner and that the cervical portion will be more tolerable to the soft tissues surrounding it. The work of the periodontist has had a most beneficial effect upon the attitude of those attempting artificial restorations in that their attention has been called to a lack of tolerance of rough edges or overhanging margins by the gingivae. All dental restorations must be made tolerable to the soft tissues or the epithelium of the gums will refuse to assume its proper relation to the neck of the tooth. The gingivae will recede after first becoming diseased and inflamed over a period of time. When the epithelium does recede to expose the cementum, greater care on the part of the patient is necessary, and the dentist must make a greater and more frequent effort to keep the cementum or exposed dentin clean and smooth enough.

The part that periodontics plays in the preparation of teeth and the maintenance of a healthy mouth is now receiving well-justified consideration. In no case should restorative preparations be attempted until the proper amount of periodontic work has been accomplished. A clean field of operation is just as essential to a good end-result in restorative work as it is in general surgery.

### PREPARING TEETH FOR RESTORATIONS

*Preparation of the Teeth Through Restorations.*—The preparation for restorations is based upon tooth relations, tooth structures and the relation of the teeth to the investing tissues. Before the

advent of so-called "full-mouth restorations," dentists never considered restoration of articulation in designing their tooth preparations. They merely prepared cavities designed to accept and retain the filling material of choice. They were conscious only of the necessity (1) of anchoring the filling; (2) of not impinging too much upon the pulp; (3) of making the filling tolerable to the gingiva, and (4) of making nice margins with "extension for prevention." The failure of dentists to make the contours of their fillings blend with the contours of the teeth is very plainly evident everywhere. It probably never occurred to many of the very conscientious dentists that tooth preparation had anything to do with the final contour of the filling. In nearly every case of patients past the age of 25, or even younger, we find that the crowns had been mutilated by being poorly restored by badly contoured inlays or by large shapeless amalgam fillings. Even in small fillings, plaster or stone casts made of the dental arches will show clearly the fillings which bulge beyond the outlines of the teeth.

A good restoration should be so natural that its area cannot be detected in a well-made cast. For me to tell you that this is easy or will ever be easy to accomplish would be stretching the truth. Making dental prostheses look and function naturally is one of the most difficult things the hand of man ever attempted, but it can be done, and I firmly believe that the teeth are important enough to warrant the extreme care, time and patience necessary to accomplish it, and I further believe that the ultimate best results demand that we expend the necessary effort to assure "naturalness" in our restorations.

*Beyond Dr. Black.*—The preparation of individual teeth in treating carious cavities or for accepting appliances to eliminate the vacant spaces of missing teeth is now influenced more by the concept of functional restorations than in the days when Dr. Black laid down his basic principles of cavity preparation. He was interested primarily in the retentive and preventive cavity form for individual foil and amalgam fillings. Nowhere in his work, to my knowledge, did he consider the function of the mouth as his ultimate goal. Individual fillings so placed seldom lend themselves to the possibilities of good occlusive or articulative restorations. Nearly all of such fillings in plaster casts appear obtrusively out of harmony with the contour of the surrounding tooth form. The foot-prints, and some have said the thumb-prints, of the dentist are immediately apparent in nearly every plaster cast of patients with dental restorations. We have yet to see a single individual filling so placed that it is not conspicuous in a plaster or stone cast reproduction because of its poor form and because it does not blend with its tooth contours.

*Preliminary Routine Preparations.*—The fundamental problem of dentistry is the diagnosis of the conditions of the teeth individually and collectively, from the study casts, together with the roentgenograms, and ocular examination of all the tissues of the mouth; to determine the health of the soft tissues and whether the patient can or cannot chew. The departures from the normal should be carefully considered from the standpoint of whether the mouth is functioning at its own expense. It is possible for the mouth to satisfactorily masticate the food, but, at the same time, to be doing it at the expense of its own physiologic integrity. A mouth organically out of tune may chew the food, but, in so doing, destroy itself just as an organically diseased heart may pump the blood to the entire satisfaction of the rest of the body, but, in so doing, wear itself out. This concept is vital to the future of dentistry. General physical diagnosis is based upon the idea of finding the flaws of the body organization before the patient is conscious of their existence and

taking steps to make the necessary corrections before irreparable damage has been done.

The general principles of physical diagnosis are directly applicable to dental diagnosis if practiced with this concept as the basis of study. Physical diagnosis has meant little to dentists because they have not been able to interpret its principles in terms of dental diagnosis. A study of the teeth individually and collectively from the study casts after the casts have been properly related to each other on an instrument reproducing jaw relations should, with the aid of roentgenograms, reveal the organic anomalies of the masticating apparatus. We should be able, from the diagnosis, to detect the potential disease-producing conditions and then complement this diagnosis with an idea of what health-giving and health-maintaining conditions of the teeth can be produced in our remedies. When we can do that, we shall be practicing dentistry as a health service.

It is not enough for dentistry to establish comfort and satisfaction on the part of the patient regarding the condition of the mouth. We should not, as physicians to the mouth, merely enable our patients to lose their teeth comfortably. I am sorry to say that a great deal of the practice of general medicine is based upon the idea of keeping people comfortable. However, medicine seems to be waking up to the fact that it must do more than merely comfort humanity, and so it is making a plea for periodic health examinations to detect health-destroying conditions before the patient is aware of them, mere comfort alone not being the idea of such a concept of the practice of medicine. Whether we can say that physicians are prepared to meet the requirements of the conditions so set up is beside the point in deciding whether the idea is good or bad. To keep people well will call for better diagnosis and the application of that familiar adage "a stitch in time."

So-called mouth reconstructions should not be applied solely to the dental cripple. Any potential disease conditions should be understood and dealt with before "crippling" has developed.

It is to be understood that any gingivitis, periodontosis, alveolar abscesses or any other infective processes must be eliminated or cured or on the way to recovery, before any restorative tooth preparations are definitely completed. In other words, the mouth, the environment of the teeth, is prepared as much as possible before final restorations are attempted. The preparation of the mouth for restorations has for its purpose the establishment and maintenance of health. Because of this, I do not advocate the retention of pulpless teeth, impacted teeth or teeth with insufficient periodontal support.

Dentistry should be health-inducing as well as health-maintaining and, if it is practiced for that purpose, we shall find our restorations contributing to the cure of the mouth conditions. Restorations then become true dental remedies. Dentistry so practiced has no limit to its health-giving and health-maintaining possibilities, not only to the mouth, but also to the body in general, and the dentist becomes truly a mouth physician.

When I see some of the things that are done and hear some of the practice-building talks, I cannot believe that there is a proper appreciation of the possibilities of our field of operation as a part of preventive medicine. Men have said the next great step in preventive medicine must be taken by dentistry, but they had in mind merely the elimination of the mouth as a source of infection. Not one, as far as I have been able to learn, showed any understanding of the teeth as a necessary factor in maintaining the health of the mouth and, incidentally, the health of the body. The next great step in preventive medi-

cine can be taken by the dentist when he conceives oral physiology, that is an understanding of how the mouth chews, as the basis of his preparations for making restorations of carious or missing teeth.

*Procedures.*—When we are ready to begin the individual preparation of the teeth, it is not always easy to select the most advantageous point of approach. Usually, it is best to begin on the molars and bicuspids, selecting those teeth most urgently in need of attention. If anesthesia is used, it is well to prepare two or more teeth under the one anesthesia. All old fillings are removed and the teeth are thoroughly prepared, particularly with regard to the cavity margins.

It is not always necessary to remove all the decayed dentin at this time, especially if in so doing undercuts would be made in the cavity, but enough of the decayed matrix must be removed for us to be quite sure of the condition with which we are dealing, that we may know that all the caries left can be removed at the time of setting the inlay and be replaced with cement without any disagreeable complications in the form of the cavity or in pulp involvement. If we cannot be reasonably sure of what is involved in the carious area, all of the decay must be removed and any undercuts may be filled with cement, which is to be removed just prior to the final cementation so that only new cement is present under the inlay. This part of the procedure admits of a great latitude of judgment. One operator would proceed in one way and another in another—all to the same end. If the proper objective is in view, the road which we travel to get there is of minor importance.

*Parsimony in Cutting Away Tooth Tissue.*—Careful analysis of the casts and roentgenograms will save tooth tissue. Great care should be used not to cut away more tooth tissue than is absolutely necessary. However, to retain tooth tissue that is in the way of properly contouring our fillings is just as bad or even worse than too much cutting. Parsimony in tooth cutting is a virtue that must not be overlooked.

Since it is impossible always to foresee the final preparation, it will often be necessary to reprepare some of the teeth when the time comes to articulate the restored areas. It is much better to err on the side of too little cutting in our first attempt at tooth preparation than to cut recklessly. We can always cut more, but there is no means of replacing what we cut away. If we are to use inlays, during the making of the wax patterns the proper placement of the cusps and grooves will often dictate a repreparation. This may be avoided to a great extent by making duplicate study casts in one of which the proposed teeth preparations are outlined and wax patterns therein articulated. These prepared study casts will serve as an index to the preparation of the natural teeth. The dentist should never hesitate to reprepare a tooth and to make any improvements in the preparations that may be indicated in his attempts at articulation. Even though a die has been made of the original preparation, the repreparing need not require a new set of mass dies, but only one for the individual tooth, as the articulating pattern may be transferred to the die of the reprepared tooth and the cavity fit perfected without in any way interfering with the articulative cusps and grooves. It is often necessary to work out the best tooth preparation gradually as the needs of the restoration dictate it.

*General Principles.*—There can be no standard forms in restorative preparations. Each preparation must be idealized according to the specific problem which it presents in its articulative requirements. There might be noted a

few general principles that are applicable to every case:

1. The cavity outline must be of such character that the filling or inlay can blend naturally into the remaining contour of tooth structure.

2. The cavity margins should fulfil Black's postulate of extension for prevention and, further, no margin in any restoration should be left on the occlusal surface where an opposing cusp or ridge will strike directly upon it. Such margins will fail, generally with disastrous results to the tooth, and lone cusps should not be left standing to be broken off. Teeth properly restored will be used, and in few cases will lone cusps stand the forces of mastication. Splitting of teeth from such a procedure is quite common.

3. Flat gingival seats, square walls and a reasonable depth are just as essential today as when Black advocated them. Even with the hardest restorative materials, teeth in proper use will swage or break the material if it does not have body enough, and loosen the filling.

4. All cavity margins should be in sound tooth structure. We may be compelled to violate this rule in special cases in order to contribute to the looks of the restoration. Herein lies the main reason for detecting caries in its incipiency. The restoration may be as extensive, but we are insured sound structure for the margins. Any compromise on this rule is fraught with danger and should be made with that thought. It was once advocated that all proximo-gingival margins be under the free margin of the septal tissue. I believe that it is unnecessary to cut away sound tooth structure to accomplish this.

5. On the incisors and canines, the proximo-axial line should be laid down in such a way that the minimum amount of filling material will be disclosed. Then the remainder of the cavity preparation should be made in accordance with this line, thus assuring the greatest esthetic values. Following this rule will conceal the restoration, and, when applied to the bicuspids and molars, will assure a result wherein the filling material will not be in the least conspicuous. This form of cavity preparation cannot be accomplished by the slice method. This method, so widely advocated by many dentists, is a pernicious, unnecessary destroyer of tooth structure and, in my opinion, should never be resorted to. It does not make for good retention and may endanger the pulp horn in many cases. Burs, stones and chisels are the best instruments for cavity preparation.

6. All the margins of the cavity should be beveled to conform to the requirements of the filling material of choice. Long beveled margins are not desirable for inlays because the sharp edge of the inlay cannot be finished smooth and, with a little erosion, becomes a definite irritant, especially at the gingival margin.

7. At all times, the occlusal and gingival table and the buccal, labial, lingual and axial walls must be carefully related to each other and, at the same time, the vitality of the pulp must be protected. The condition of the tooth as regards the amount of decay or previous restorations will, to a great extent, dictate the position of these walls, but, at all times, the future welfare of the pulp must be uppermost in the mind of the operator.

8. At all times, the fundamental physiology of the mouth, *how it chews,* should form the basis of all tooth preparation. We are not merely "stopping" holes in teeth if we have in mind "Dentistry as a Health Service."

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# CENTRIC AND ECCENTRIC OCCLUSION IN FULL DENTURES, WITH THE MANDIBULOGRAPH

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THE mandibulograph is a simple instrument that is used intra-orally and extra-orally in the construction of full dentures, to improve mastication, to reduce painful abrasions and to diminish resorption of the ridges. It is used intra-orally to record in one operation: the unstrained centric relation, the resilience of the tissues and the movements of the mandible. It is used extra-orally, with the intra-oral record, to correlate the occluding areas of the teeth with the movements of the mandible without the use of an adjustable articulator.

In mandibulographing, it is important that only those movements be recorded that the patient is accustomed to using. The incising and masticating movements are the natural ones, and it is from these that the unstrained centric relation is obtained.

When the necessary incising and masticating movements are completed, the records thus obtained are called a mandibulogram.

The instrument consists of a stylus, a stage and a key for locking and making the fine adjustments. The stylus has three recording needles and a central bearing point and is attached to the upper base-plate. The stage is placed on the lower base-plate and is covered with a special wax to receive the recordings of the stylus. (Fig. 1.)

In recording, in addition to the movements of the mandible, the resilience of the soft tissues upon which the dentures rest is a factor in the occlusion.

Read before the National Society of Denture Prosthetists, 1939.

To illustrate what takes place in a lower denture during mastication, let us assume that the dentures are in centric occlusion and that pressure is applied as in crushing food. It is obvious that the tissues are compressed evenly. When mastication takes place on the right side, the tissues are compressed on the right side. A similar compression takes place in incising and in masticating on the left side. These eccentric compressions are automatically recorded by the mandibulograph. In masticating for the record, the tissues of the upper and the lower jaw are compressed approximately 1 mm. for the average case.

It is interesting to note that the muscles which control the mandible do not function as they did when the teeth were in the mouth. Many of their attachments are close to the crest of the ridge, and there is a general change in their size, shape, tone and ability to function. Therefore, in mandibulographing, attention is directed more toward the muscles and the ligaments than to the bone.

For a better understanding of the various mandibular movements, I shall divide these movements into two general groups, the strained, or unnatural, and the unstrained, or natural, movements. The strained mandibular movement is the thrusting of the mandible to one side or the other or projection of it forward. These movements are difficult to perform and still more difficult to record. Patients tire quickly and the position is constantly changing.

Unstrained movements are incising and masticating. An unstrained move-

ment that has been the source of a great deal of confusion in the minds of prosthetists in taking centric relation is the movement of the mandible in crushing food and in swallowing. It is very short (between 1 and 2 mm. for the average case) and is from centric position forward, frequently along the protrusive line. It is easy to register this movement by having the patient swallow, bite or make the posterior teeth chatter.

However, if the teeth are occluded to this protrusive position, the patient will be just as uncomfortable as if they had been to the most retruded position, which is its opposite and is a strained movement.

Although the muscles and the ligaments that control the mandible are capable of producing many movements, the

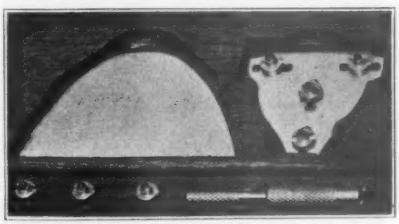

Fig. 1.—The Mandibulograph.

movements that concern the prosthetist are the natural ones of incising and masticating. These movements are in cycles; that is, the mandible leaves centric position to go to an eccentric position and returns to centric in the early stages. The segments of these cycles that pertain to occlusion are: from the first contact of the lower teeth with the upper in eccentric occlusion until centric occlusion is reached. This segment of the cycle is known as the *arc of occlusion.* (Fig. 2.)

In the incising cycle, the muscles move the mandible forward and downward as both the condyles glide forward and downward in their fossae. In masticating, the muscles move the mandible downward and to one side, using one condyle as an axis while the other condyle is moved outward. Thus, we have cycles for the incising and the right and left mastication movements, and each cycle has its arc of occlusion.

In mandibulographing, the patient registers the arcs of occlusion in which their teeth will function. The prosthetist sets the teeth and correlates the occluding areas to these arcs.

The incising arcs of occlusion vary in radius and direction with each patient. The masticating arcs of occlusion are seldom alike in one mouth, owing to the masculature, the bony structure and the habits of the patient. When an arc is high, a high cusp is used; when an arc is low, a shallow cusp is used, and thus the height of the cusps is determined.

In order to record these arcs and use them in establishing eccentric occlusion, the casts of the upper and lower have

Fig. 2.—Arc of occlusion, indicated by heavy line.

base-plates fitted to them as nearly like a finished denture as possible when processed bases are not used. The stylus frame is placed on the base-plate so that the cross-piece is on a line with the first molars and the stem just behind the central incisors. The outlines of the ends are then marked, and compound supports are placed in the marked areas as resting places for the stylus. As a reinforcement to the base-plate, a small compound rim is placed over the lingual portion of the ridge and joined to the supports.

The rim is then completed in wax and carved to about the shape we expect the finished denture to be. The rim of the lower is made entirely of compound. The base-plates are then placed in the mouth in vertical relation, and the neces-

sary fulness is established. The usual line markings are made at the same time. The base-plates are then removed from the mouth, and the buccal aspects of the upper especially are carved to resemble those of the porcelain teeth, in order that a wax "try-in" may be made. This procedure has been a great aid in maintaining fulness. It overcomes the tendency to remove more wax than is replaced with porcelain in setting up the teeth.

In mandibulographing, the use of the conventional articulator is not absolutely necessary; therefore, the use of the face-bow, check-bites, and extra-oral recording devices is eliminated, and the setting of casts simplified. (Fig. 3.) It is imperative, however, that provisions be made for maintaining and checking centric relation. A stone extension from the casts can be used, or any plain line articulator that has an incisal guidepost will be satisfactory.

Fig. 3.—Upper and lower trial bases on stone articulator.

After the centric relation retainer has been decided on, the lower cast is set in position. The lower base-plate is prepared for the stage upon which the action takes place by being fitted inside the periphery of the rim, with a step cut so that it sets well below the occlusal line, but parallel with it. The distal end extends to the region of the second molar. The stylus of the upper base-plate is placed well below the occlusal line of the upper rim on the supports previously constructed, extending distally to the first molar region. The central bearing point is adjusted so that it just touches the stage when the base-plates are in centric position. (Fig. 4.) The anterior and lateral recording needles do not touch the stage, but are adjusted to one-half the thickness of the wax that is used for recording.

After the case is tried in to check the central bearing point, that portion of the lower rim above the stage is trimmed down, and the base-plates are tried in the mouth. It is important that the central bearing point be the only point of contact between the upper and the lower when the mandible is moved in its various positions.

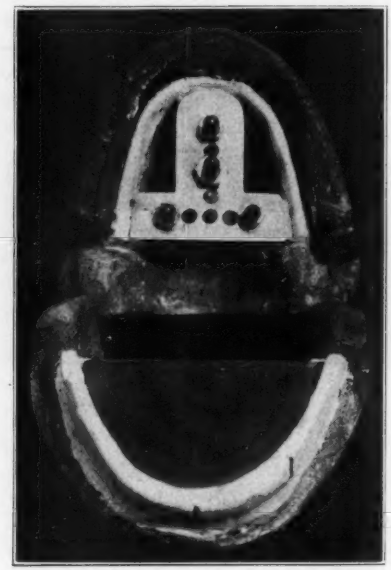

Fig. 4.—Mandibulograph in position for recording.

The bases are now removed, and the recording wax is placed over the stage and securely fastened. The upper base-plate is then inserted in the mouth. The recording area of the wax on the lower

base-plate is warmed and the base-plate placed in the mouth. The patient is instructed to move the mandible back and forth as in incising, and from side to side, as in masticating. The movements are limited to two or three until further studies are presented.

As the patient moves the mandible, the three recording needles in the upper base-plate scribe on the wax of the lower the various arcs of occlusion, just as the voice is recorded by a talking machine. The shapes of the recordings are in the forms of arrows and the point of each arrow indicates centric relation.

Mandibulograph recordings represent the masticating and incising movements of the patient in three dimensions, the horizontal, transverse and longitudinal

Fig. 5.—Wax record showing movements of mandible.

planes. (Fig. 5.) The recordings to the right and to the left are the masticating arcs of occlusion. The center recording is the incising arc of occlusion. Therefore, we not only have the arc, but also the direction of each movement. Recording the arcs in triplicate makes it possible to reproduce those segments of the mandibular cycles that are essential to the establishment of occlusion.

When the needles are at the points of the arrows, in the mouth, soft plaster injected from a waxed paper cone is used to join the upper and the lower. After the plaster has set, the cases are removed and the articulation of the casts is completed. In order to reproduce the wax mandibulogram in metal, the area is boxed with black carding wax and a stone cast is made. From the stone cast, a permanent mandibulogram is cast in metal.

In order to determine the radius of the compensating curve from the incising arc of occlusion, the cast of the mandibulogram is placed in front of a compensating curve guide, and, with a magnifying glass, the radius that coincides with the incising arcs of occlusion is readily observed.

After casting, the mandibulogram is placed on the stylus with the four points at the apices of the four arrows and fastened securely with sticky wax. The stage of the lower base-plate is removed.

Fig. 6.—Metal mandibulogram in position in tongue space.

Sculptor's clay is used to line the lingual portion of the rim, being extended across from one retromolar triangle to the other. This wall is constructed in such a manner that, when the upper and lower are brought to centric position, the mandibulogram does not touch the sides.

With the lower base-plate on the cast, stone is poured into the walled area, and the upper base-plate is brought into centric position. After the stone has set, the needles are separated from the mandibulogram, and the upper and lower base-plates are removed. The mandibulogram is now seated on a plateau inside the ridge of the lower base-plate in the

tongue space. (Fig. 6.) The central bearing point is removed from the stylus and the upper base-plate is placed in position on the mandibulogram. (Fig. 7.) The recording needles can now travel the cast arcs of occlusion as they previously did in wax in the mouth. In so doing, they reproduce the incising and masticating arcs of the mandibular cycles, and the teeth can now be arranged and the occluding areas correlated.

In order to demonstrate the method of functioning, an indicator is placed at the centric position. The recording needles are then moved to the right, which is the beginning of the arc of occlusion for that side. Here, the teeth will make their first contact on the way to centric

Fig. 7.—Reproducing movements of mandible by moving stylus in recorded paths.

occlusion, and when the teeth are ground so that the occluding areas glide freely, we have an efficient, shearing, eccentric occlusion all the way to centric position. When the needles are moved to the left, it will be noted that this arc of occlusion is not the same as on the other side.

In occlusion, centric position is recognized here as being the most important, since all other occlusions lead to centric or away from it in the early stages of mastication.

In setting up the teeth, it is suggested that the six anterior teeth be arranged first, with the carved buccal aspect as a guide. The cuspids are placed so that the distal halves are in the same buccal plane as the bicuspids. All the compound is removed from the lower base-plate, and the lower right first bicuspid is placed in position. The remaining lower posterior teeth are then placed in position on the right side, with their central passage parallel to the incising path of the mandibulogram, and the compensating curve of the buccal cusps following the template of a radius that was previously selected. Each opposing tooth is ground in separately, to the incising, the right and the left arcs. This insures an efficiency that cannot be obtained when several teeth are ground in together.

In grinding in the teeth, the recording needles of the upper are moved to the beginning of the incising arcs of occlusion and are guided along the arcs until centric position is reached. When a cusp is felt to be in the way as they travel along the paths, thin carbon paper is used to detect the high point so that it can be removed.

The upper right first bicuspid is then placed in centric occlusion and ground to the three movements. The remaining teeth are set up and ground in a like manner. Where the occluding areas have been ground smooth, supplemental grooves are ground in to facilitate the shearing process. The lower anterior teeth are set up last. The beginning of the incising arc of occlusion is at the end-to-end position and the path is up the lingual surface of the upper teeth to centric position in normal cases. After all the teeth have been ground in, the centric relation and occlusion are checked, the case is tried in, the occlusion is indexed and the case is finished in the usual manner.

After the posterior teeth have been mandibulographed, the occluding areas of the upper buccal cusps present arcs of occlusion. The buccal cusps of the lower teeth are well rounded and glide freely

in the arcs. The occluding areas of the lower teeth have supplemental grooves ground in, which increase their shearing quality. The central fossae of the lower teeth are paralleled with the protrusive line, in order that the upper lingual cusps may function efficiently and easily.

When the records of the mandibular movements are not taken, it is difficult to determine the direction of the protrusive movement and the teeth have to be set up and occluded arbitrarily. When this is done, the possibility of obtaining efficient eccentric occlusion in the arcs is remote.

The direction of the protrusive movement is important because, if the lingual cusps of the upper teeth are to function freely in incising, the central fossae must be parallel with the protrusive line to avoid zigzagging the lower.

Without a guide for occlusion, cusps are of necessity either too high or too low. When a cusp is too high, it cannot function in the arc because it strikes outside of it. In striking outside the arc, the denture is displaced, and painful abrasions are the result.

When a cusp is too low, it passes so far inside the arc that the shearing quality which is so necessary to efficient mastication is lost. However, when a record is taken, a cusp can be ground to coincide with the arcs of occlusion, and we not only have efficient mastication, but also a marked reduction of painful abrasion and a minimum of resorption.

862 Carroll Street.

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# AMERICAN DENTAL ASSOCIATION SPECIFICATION NO. 3 FOR DENTAL IMPRESSION COMPOUNDS FIRST REVISION—1939

By W. T. Sweeney,* A.B., and John R. Beall,* B.S., Washington, D. C.

AMERICAN Dental Association Specification No. 3 for Dental Impression Compounds has been revised for two primary reasons. First, test data on certified compounds and the results of clinical experience indicated that the requirements of the specification could be made more selective and, second, requests have been received for the inclusion of separate requirements for the type of compound which is intended for making trays rather than for taking impressions.

Test data from a recently completed survey of the certified impression compounds were available for study, as were the records from past surveys by the American Dental Association Research Fellowship at the National Bureau of Standards. The data from tests made by the National Bureau of Standards on materials purchased by the government were also made available to the Fellowship.

A study of these data showed that, on the basis of flow, the compounds could most conveniently be divided into two groups as follows: first, compounds which softened below 40°C. (104°F.)

A report to the Research Commission of the American Dental Association; publication authorized by the Executive Board of the Research Commission.

*Research Associate of the American Dental Association at the National Bureau of Standards.

and, second, compounds which softened above 40°C. (104°F.). The first group of materials (Fig. 1, curves 1, 2, 3, 4, 5) contains only those recommended by the manufacturers for impression taking. Among the materials falling in the second group (Fig. 1, curves 6, 7, 8, 9, 10) were those which are recommended by the manufacturers as tray compounds.

This is in accord with an analysis of the requirements for the two types of compounds. Both should be rigid at mouth temperature. The impression type should soften just above mouth temperature and should reach a working plasticity at a temperature tolerable in all mouths. The tray type should be sufficiently rigid at temperatures slightly above mouth temperature to prevent undue distortion on the addition of other impression material used to take the final impression in the mouth. In addition, the tray material must develop a working plasticity at a low enough temperature to allow forming the tray in the mouth.

The requirement of 6 per cent maximum flow at 37.0°C. (98.6°F.) in this revised specification for Type I, or impression compound, replaces the former requirement of 10 per cent maximum at 37°C. The former requirement of 2 per cent maximum at 35°C. (95°F.) was deleted, as the data indicated that compounds with 6 per cent or less flow at 37.0°C. (98.6°F.) would have less than 2 per cent flow at 35°C. A new requirement of 20 per cent minimum flow at 40.0°C. (104.0°F.) has been introduced to insure that Type I compounds soften below 40.0°C. A working plasticity, 85 per cent minimum flow, must be reached at 45.0°C. (113.0°F.) for compliance with the revised specification.

A 2 per cent maximum flow at 37.0°C. (98.6°F.) has been set for Type II, or tray compounds, to insure rigidity at mouth temperature. Material softening below 40.0°C. (104.0°F.) is eliminated by a requirement of 15 per cent maximum flow at 40.0°C. The working plasticity of tray compounds (90 per cent minimum flow) must be reached at or below 50.0°C. (122.0°F.). Thus, the temperature at which a working plasticity is reached may be lower for both types of compound in the revised specification than in the original specification.

Specimens for the flow tests were pre-

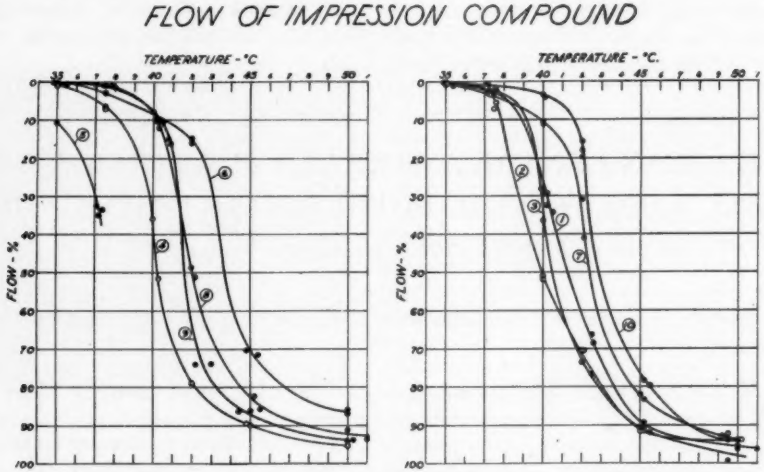


Figure 1.

pared by pouring the compound (melted at the lowest possible temperature) into holes 10 mm. in diameter in a steel block 6 mm. thick. In order to make satisfactory ends on the specimens, the block was supported on a flat surface. The holes were overfilled and a flat plate was pressed down on the mounds of compound thus formed until the compound had hardened. The ends of the cylindrical specimens were then made plane and parallel by carving and finishing to ±0.01 mm. on a fine abrasive paper. The specimens were aged at room temperature for at least twenty-four hours before the test. This yields more consistent results than are usually obtained when freshly made specimens are tested. The flow test methods remain unchanged.

The shrinkage requirement has been deleted because experience in testing the compounds certified to the Research Commission has shown that those which met the flow requirements have also met this requirement. Furthermore, the use of a technic in which the final impression is made with only the surface layer of compound softened by flaming (after a preliminary impression has been taken and allowed to cool) greatly reduces the effect of shrinkage, as the bulk of the compound has only a small range of temperature through which to cool.

An additional test for working qualities has been developed and incorporated in the revised specification. This is a test in which the compound must take a satisfactory impression of a test block under prescribed conditions.

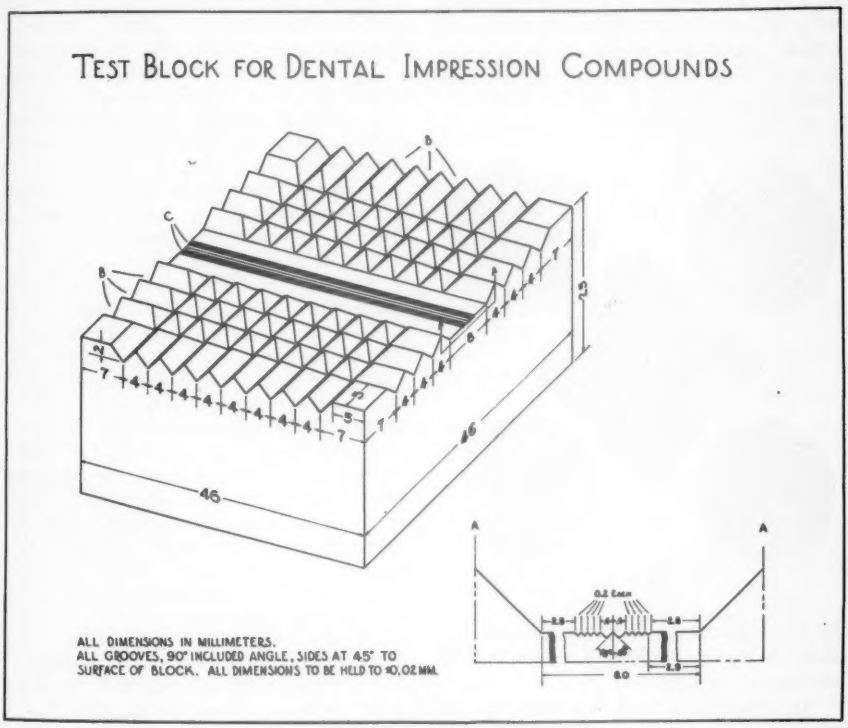
TEST BLOCK FOR DENTAL IMPRESSION COMPOUNDS
ALL DIMENSIONS IN MILLIMETERS.
ALL GROOVES, 90° INCLUDED ANGLE, SIDES AT 45° TO SURFACE OF BLOCK. ALL DIMENSIONS TO BE HELD TO ±0.02 MM.

Figure 2.

The design for the test block (Fig. 2) was selected as it is relatively simple and has large irregularities (grooves B, Fig. 2) and very fine detail (grooves C, Fig. 2). The block and samples of good and poor impressions of it are shown in Figure 3.

RÉSUMÉ

The materials which comply with the requirements of the revised specification as Type I compounds will be essentially the same as the majority of materials which complied with the previous specification. To comply with the revised specification, however, the working plasticity must be reached at a substantially lower temperature than heretofore, and thereby the possibility of discomfort to the patient be reduced.

An impression test has been incorporated in the revised specification using a test block and a definite procedure to determine whether Type I compounds will correctly reproduce large irregularities and fine detail.

The requirements for Type II in the revised specification define a harder, stiffer compound, the primary use of which is to form trays for holding other impression materials used in taking the final impression.

Other requirements of the revised specification remain essentially the same as those in the previous specification.

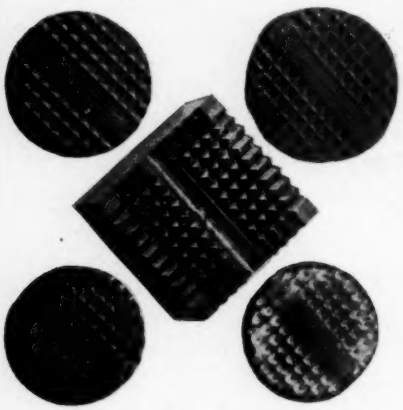

Figure 3.

AMERICAN DENTAL ASSOCIATION
SPECIFICATION NO. 3
FOR
DENTAL IMPRESSION COMPOUNDS
FIRST REVISION ADOPTED BY
AMERICAN DENTAL ASSOCIATION, JULY 1939
EFFECTIVE JULY 1, 1940

*A. General Specification.*

This specification is for dental impression compound, the primary uses of which are:

A-1. The taking of impressions in the oral cavity.

A-2. The forming of trays to be used for holding other impression materials.

*B. Types.*

Impression compounds shall be of the following types.

Type I. Impression compound.

Type II. Tray compound.

*C. Material.*

C-1. Type I. The material shall be uniform and suitable for taking impressions in the oral cavity.

C-2. Type II. The material shall be uniform and suitable for forming trays to be used in the oral cavity.

*D. General Requirements.*

The compound shall have the following properties:

D-1. Homogeneity throughout.

D-2. A smooth, glossy surface after flaming.

D-3. Firm, smooth margins after trimming at room temperature.

*E. Detail Requirements.*

E-1. Type I. Impression Compound.

E-1a. The flow at 37.0° C. (98.6° F.) shall not be more than 6.0 per cent.

E-1b. The flow at 40.0° C. (104.0° F.) shall not be less than 20.0 per cent.

E-1c. The flow at 45.0° C. (113.0° F.) shall not be less than 85.0 per cent.

E-1d. The compound shall record accurately the complete surface detail of the test block (Fig. 2) at 45.0° C. (113.0° F.).

E-2. Type II. Tray Compound.

E-2a. The flow at 37.0° C. (98.6° F.) shall not be more than 2.0 per cent.

E-2b. The flow at 40.0° C. (104.0° F.) shall not be more than 15.0 per cent.

E-2c. The flow at 50.0° C. (122.0° F.) shall not be less than 90.0 per cent.

*F. Methods of Inspection and Test.*

F-1. Preparation of specimens.

F-1a. Flow specimens. The mold used in forming the cylindrical flow specimens shall be a flat metal plate 6.0 mm. (0.236 in.) thick, containing one or more holes 10.0 mm. (0.394 inch) in diameter. The mold shall be warmed and placed upon a smooth flat surface. Sufficient compound which has been heated to just above its melting range shall be poured into the mold until it is "overfilled." A smooth flat plate shall then be placed on top of the mold and pressed down until the compound becomes rigid. After cooling, the ends of the specimens shall be made plane and parallel. The specimens shall be at least 24 hours old before testing.

F-1b. Impression specimen. The impression specimen shall be a disk 40 mm. (1.57 inches) in diameter and between 4 mm. (0.16 inch) and 7 mm. (0.28 inch) in thickness. The cake of compound shall be warmed in water and the disk cut. If the cake is thinner than 4 mm. (0.16 inch), two cakes shall be flamed and pressed together before cutting the disk.

F-2. Methods of Test.

F-2a. Flow tests. The length of each specimen shall be measured at room temperature 20-25° C .(68-77° F.). Twenty minutes shall be allowed prior to testing for the specimen to come to the required temperature. A thin sheet of cellophane shall be placed between the instrument and each end of the specimen, which shall then be subjected to a constant axial load of 2,000 gm. (4.4 pounds) for ten minutes. The specimen shall then be removed and, after it is cooled to room temperature and the cellophane stripped out, the final length shall be determined.

The flow, as evidenced by the change in length, shall be reported as percentage of the original length. The value for flow at any temperature shall be the average value for two specimens and shall be reported to the nearest 0.1 per cent.

F-2b. Impression Test. A water bath shall be adjusted to 45.0° C. (113.0° F.). A flat plate (to support the specimen while it is coming to the required temperature), a test block (Fig. 2) and a weight, having a base approximately 50 mm. (1.97 inches) in diameter and weighing 1,000 gm. (2.2 pounds) in air, shall be placed in the bath and allowed to come to the temperature of the bath. (The water level in the bath shall be 30±5 mm. [1.18±0.19 inches] above the top surface of the test block.)

The impression specimen shall then be placed in the water bath on the flat plate. Twenty minutes later, the specimen shall be centered on the test block, a sheet of cellophane shall be placed over the specimen and the weight shall be placed on the specimen. Ten minutes later, the weight shall be removed, the test block and specimen shall be taken from the bath and chilled and the specimen shall be removed from the test block.

The impression shall be considered satisfactory if the ridges corresponding to the large cross grooves (B, Fig. 2) of the test block are sharp, and the ridges corresponding to the fine grooves (C, Fig. 2) are complete and visible to the unaided eye for at least 30 mm. (1.18 inches) of their length.

*G. Packaging.*

G-1. The minimum net weight of the contents shall be indicated on all packages.

G-2. Each package shall be marked with a serial number or a combination of letters and numbers which refer to the manufacturer's records for the particular lot or batch of compound.

G-3. The date of manufacture (year and month) shall be indicated on each package as a separate item or as a part of the serial number.

G-4. Instructions, including method of softening, working temperature and a curve or data showing the shrinkage of the compound from 40° C. (104° F.) to 20° C. (68° F.) shall be supplied with each package.

# CHANGES IN HYDROGEN-ION CONCENTRATION ON TOOTH SURFACES AND IN CARIOUS LESIONS

By Robert M. Stephan, D.D.S., M.S., Chicago, Ill.

IN any attempt to understand the fundamental nature of dental caries, one is confronted by the question "What is the mechanism by which enamel and dentin are dissolved from teeth, under the conditions that exist in the mouth?"

The mass of evidence which led W. D. Miller[1] to formulate the "chemicoparasitic" theory of caries offers a logical starting point for seeking an answer to this question. We may summarize his findings and theory thus: Caries is a process of dissolution of the calcium salts from enamel and dentin by acids, formed in the mouth by fermentation by bacteria of carbohydrates lodged on tooth surfaces. This process is followed by disintegration of the organic matrix by proteolytic action of the same or other bacteria.

Miller's experiments did not simulate beginning caries of enamel. His experiments did not seem to explain why the acid produced on tooth surfaces was not neutralized by saliva. To fill this gap in the chemicoparasitic theory, others conceived of a "plaque" or "film" on the tooth surface which confined acid to the tooth surface and prevented neutralization by saliva.

Williams[2] demonstrated adherent bacterial plaques on surfaces of teeth, including some with beginning caries of the enamel. Black[3] presented evidence of "gelatinous plaques" produced by gelatinizing bacteria on those surfaces of teeth which were not cleaned either by a brush or in mastication.

Kirk[4] presented evidence that mucin was precipitated from the saliva to form a "mucin plaque."

Recently, Wach* has shown that mucin is precipitated on cellophane bags containing lactic acid solutions with pH 3 to 7 when they are suspended in saliva. This layer of precipitated mucin greatly retards the diffusion of lactic acid from the bags. Such a mucin "plaque" precipitated on the surface of teeth would be capable of preventing the diffusion of acids from the tooth surface.

Regardless, however, of whether the nature of the caries-producing "plaque" is bacterial, gelatinous, mucinous, composed of food particles or any combination of these, theoretically it is necessary for the plaque to develop a sufficient hydrogen-ion concentration to dissolve enamel, in order for the carious lesion to develop.

There have been many investigations of the factors governing the solubility of the enamel. McClelland,[5] Enright, Friesell and Tresher,[6] Kanthak,[7] Chase[8] and others have all indicated that the hydrogen-ion concentration is the chief factor in the solubility of enamel. The present evidence indicates that, in a solution containing as much calcium phosphate

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*Not yet published.

as saliva, the enamel will not dissolve above a pH of about 5.0 to 5.5, but will dissolve below this pH. Since the pH of saliva is almost always from 6.0 to 7.8, it is obvious why the saliva does not dissolve enamel. Since enamel is dissolved in beginning caries, it would seem logical that something on the enamel surface attains a pH less than 5.0-5.5. The measurement of this pH is important in order to determine the immediate activity of the carious process.

There are several methods of measuring pH, none of which is without some disadvantages.

The microcolorimetric technic used by the writer[9] in a reported study showed variations in pH of plaques from 4.6 to 7.0, and of carious débris from 4.2 to 7.0. This method required considerable time and patience, and therefore it was difficult to make many tests on material from tooth surfaces at one time. The material tested was removed from the mouth, and only one measurement was possible.

Electrometric methods have proved applicable for repeated direct measurements of pH *in vivo*.[10, 11] The glass electrode has the fewest errors. Microglass electrodes small enough to be applicable for pH readings on tooth surfaces have two serious limitations: 1. The electrodes are very fragile, and they break with slight pressure. 2. Their electrical resistance is so high that thorough electrostatic shielding is necessary. Thus far, these limitations have hindered their use directly on tooth surfaces. The antimony electrode has neither of these limitations.

Parks and Beard[12] have shown that a polished stick electrode, in the presence of air, and with a vacuum tube potentiometer-electrometer which would pre-

Table 1.—Antimony Electrode

| Advantages | Limitations |
|---|---|
| Electrodes rugged | Accuracy limited to 0.2 pH from pH 2-7, except under special conditions |
| Can be used on very small quantities of material | Oxidizing—reducing systems may cause error |
| Highly polished surface easily cleaned | Not applicable to all solutions—susceptible to small amounts of copper |
| Exerts negligible buffer effect | Thermionic amplification recommended to avoid polarization of electrodes; may introduce electrostatic influences |
| Can be used on viscous and semisolid material | |
| Has low resistance | |
| Readings immediate | |

Table 2.—Comparison of Antimony Electrode Readings with Glass Electrode Readings*

| | pH | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Glass electrode | 3.50 | 4.00 | 4.50 | 5.00 | 5.50 | 6.00 | 6.50 | 7.00 | 7.50 | 8.00 |
| Antimony electrode 1 | 3.55 | 4.00 | 4.50 | 4.91 | 5.45 | 5.99 | 6.54 | 6.92 | 7.37 | 7.87 |
| Antimony electrode 2 | 3.45 | 4.00 | 4.51 | 5.09 | 5.44 | 5.85 | 6.40 | 6.92 | 7.42 | 7.82 |
| Antimony sulfide electrode | 3.50 | 4.01 | 4.51 | 5.01 | 5.48 | 5.98 | 6.48 | 6.92 | 7.41 | 7.80 |
| Antimony sulfide electrode | 3.58 | 4.00 | 4.47 | 4.96 | 5.45 | 5.99 | 6.44 | 6.95 | 7.35 | 7.82 |

*Directly in pH on saliva-lactic acid mixture at 25° C., electrode standardized with pH 4.1 buffer.

vent polarization of the electrodes, followed the theoretical Nernst equation from pH 2-7 at 25° C., the greatest deviation being 0.2 pH unit.

T. R. Ball[13] showed that an antimony sulfide electrode functions between pH 1.8 and pH 10, with results reproducible to 0.09 pH unit. Citrates rendered the electrode useless, but 10 per cent sugar, 2 per cent starch and 0.5 molar sodium nitrate were without effect.

The chief advantages and limitations of the antimony electrode have been listed in Table 1.

TABLE 3.—pH READINGS FROM MOUTH WITH RECENT CAVITIES NEWLY FILLED

| Case 34 | Man, aged 25 | | 4-22-38 | | Sucrose 11 A.M. |
|---|---|---|---|---|---|
| | pH of Plaques on Buccal or Labial Surfaces | | | | |
| Tooth | Time 10:55 A.M. | 11:04 A.M. | 11:20 A.M. | 11:45 A.M. | Maximum Variation |
| 3+ | 6.8 | 4.5 | | 6.4 | 2.3 |
| 4+ | 6.9 | 4.7 | | 6.3 | 2.2 |
| 5+ | 6.9 | 5.0 | | 6.3 | 1.9 |
| | | | Colorimetric | | |
| 6+ | 6.7 | 4.7 | 4.6 | 6.3 | 2.1 |
| 7+ | 6.7 | 5.2 | 4.8 | 6.3 | 1.9 |
| 8+ | 5.8 | 4.7 | 4.6 | 5.4 | 1.2 |
| Average | 6.6 | 4.8 | 4.7 | 6.2 | 1.9 |

TABLE 4.—pH READINGS FROM MOUTH WITH RECENT CAVITIES NEWLY FILLED

| Case 34 | Man, aged 25 | 5-13-38 | Glucose 11:48 A.M. | 1:54 P.M. | | |
|---|---|---|---|---|---|---|
| | pH of Plaques on Buccal or Labial Surfaces | | | | | |
| Tooth | Time 11:40 A.M. | 11:50 A.M. | 12:06 P.M. | 1:45 P.M. | 1:55 P.M. | Maximum Variation |
| 3+ | 6.7 | 5.3 | 4.6 | 6.2 | 5.2 | 2.1 |
| 4+ | 6.9 | 5.0 | 4.8 | 6.3 | 5.2 | 2.1 |
| 5+ | 6.9 | 5.1 | 4.8 | 6.2 | 5.2 | 2.1 |
| 6+ | 6.9 | 4.7 | 5.0 | 6.3 | 5.2 | 2.2 |
| 7+ | 6.8 | 4.8 | 5.0 | 6.3 | 5.0 | 2.0 |
| 8+ | 6.0 | 4.6 | — | — | — | 1.4 |
| Average | 6.7 | 4.9 | 4.8 | 6.2 | 5.2 | 2.0 |

## METHOD

Several types of antimony electrodes were tried. Some electrodes were made by electrolytically depositing antimony on platinum wire. These electrodes did not stand up in use, because the antimony soon began to flake off the platinum wire.

Highly polished sticks of cast antimony gave the most reliable readings. These sticks were 0.3 mm. in diameter and one end was shaped to a small rounded tip and highly polished to a mirror finish. The other end was soldered to a flexible insulated copper wire. The electrode was sealed in a glass tube with wax so that only the polished tip was exposed. This tip was the only part of the electrode placed in contact with the plaque or cavity when pH readings were being made. Some of these electrodes were given an antimony sulfide coating, but no great advantage was noted.

A Coleman potentiometer-electrometer was used to measure the potential of the system, and readings were made directly in pH units.

Table 2 shows comparative tests made with two antimony and two antimony-sulfide electrodes and the glass electrode on saliva-lactic acid solutions at 25° C. It will be noted that the maximum variation was less than 0.15 pH unit in the range of 4.0 to 7.0 pH. This variation

The influence of the liquid junction potential between the floor of the mouth and 0.9 per cent sodium chloride bridge, and of the body potential between the floor of the mouth and the tooth surface, was checked by placing a drop of the pH 4.1 buffer on a tooth and taking the pH reading with the antimony electrode. This reading was found to vary from 0.0 to 0.2 pH unit from the buffer reading made in standardizing the electrode.

TABLE 5.—pH READINGS FROM MOUTH WITH SIX CARIOUS LESIONS

| Case 31 | Man, aged 18 | 5-6-38 | Boiled Starch 10:39 A.M. | |
|---|---|---|---|---|
| | | pH of Buccal or Labial Plaques | | |
| Tooth | Time | 10:30 A.M. | 11:30 A.M. | Variation |
| +1 | | 5.6 | 5.0 | 0.6 |
| 1+ | | 6.0 | 4.4 | 1.6 |
| 2+ | | 6.7 | 5.1 | 1.6 |
| 3+ | | 6.5 | 5.0 | 1.5 |
| 4+ | | 6.5 | 5.0 | 1.5 |
| 5+ | | 6.0 | 4.9 | 1.1 |
| 3+ | Mesial Cavity | 6.7 | 4.7 | 2.0 |
| Average | | 6.3 | 4.9 | 1.4 |

TABLE 6.—pH READINGS ON PLAQUES FROM ENAMEL SURFACES

| Case 48 | Man, aged 21 | 12-2-38 | 1% Lactose 6:35 P.M. | 1% Glucose 6:42 P.M. | |
|---|---|---|---|---|---|
| Tooth | Time 6:30 P.M. | 6:38 P.M. | 6:45 P.M. | Variation Lactose | Variation Glucose |
| +3 | 5.5 | 5.3 | 4.3 | 0.2 | 1.2 |
| 2+ | 6.5 | 5.8 | 4.6 | 0.7 | 1.9 |
| 4+ | 6.4 | 6.1 | 4.8 | 0.3 | 1.6 |
| 5+ | 6.1 | 6.0 | 4.8 | 0.1 | 1.3 |
| Average | 6.1 | 5.8 | 4.6 | 0.3 | 1.5 |

is comparable with that found by Parks and Beard.

Before the antimony electrode was used in the mouth, it was standardized with a buffer of pH 4.1, so that readings could be made directly on the pH scale of the potentiometer-electrometer.

A calomel reference electrode was used. Contact was made to the body with a 0.9 per cent sodium chloride bridge. This contact was made on the floor of the mouth.

Electrostatic influences were eliminated by having the patient grounded by holding a water pipe.

Tables 3-4 are readings from a mouth with several dental cavities of recent development that had just been filled. These readings were from plaques on the labial and buccal surfaces near the gingival line. Table 3 shows the influence of rinsing the mouth with a 10 per cent sucrose solution for one minute. The average maximum variation was 1.9 pH

units. The three pH readings made by colorimetric method are listed. It should be noted that the plaques were near their original pH forty-five minutes after the sucrose rinse.

Table 4 shows the effect of a 10 per cent glucose rinse. The average maximum variation was 2.0 pH units. In eighteen minutes after the rinse, all of the plaques were 5.0 or less, but about two hours later the plaques approached their original pH. A second glucose rinse had an effect similar to that of the first rinse.

Table 5 lists readings on a mouth with six carious lesions. The readings were taken from cavities and plaques before and after rinsing the mouth with a boiled cornstarch solution for one minute. The average maximum variation at the end of fifty-one minutes was 1.5 pH units. The mouth was kept inactive during this time. The cavities showed the greatest variation in pH.

Table 6 lists readings on plaques from enamel surfaces which were whitened and have since developed cavities. Three minutes after rinsing the mouth with a 1 per cent lactose solution, the average maximum variation was 0.3 pH unit. Three minutes after rinsing with a 1 per cent glucose solution, the average maximum variation was 1.5 pH units.

The tables show some of twenty-three cases which have been tested with the antimony electrode. The average pH of 342 readings on plaques before the mouths were rinsed with 1 per cent glucose was 6.2, whereas readings from two to sixty minutes after the mouths were rinsed with 1 per cent glucose averaged 5.1 This is an average variation of 1.1 pH units. For open cavities, the average pH of 192 readings was 5.5 before the mouths were rinsed with 1 per cent glucose, whereas readings from two to sixty minutes afterwards averaged 4.7. This is an average variation of 0.8 pH units.

The lowest pH in five proximal cavities which were opened by operative procedure with a rubber dam in place was 4.1 to 4.6. No carbohydrate was added to these cavities in making these readings.

The findings seem to support the chemicoparasitic theory of the etiology of dental caries. The most interesting observation is that within two minutes after rinsing the mouth with a glucose or sucrose solution, the pH may drop as much as 3 units, which represents an increase in the hydrogen-ion concentration of a thousand times. This indicates that an efficient enzyme system is present in plaques. The indication that lactose solutions do not have this marked lowering effect on plaques suggests that the mechanism is specific for certain carbohydrates.

The findings support the old belief that the eating of candy is apt to increase decay of the teeth. They indicate that it is the local influence of the presence of sugar on the tooth surface rather than the systemic influence of its ingestion that may lead to active caries.

The finding that the effect in lowering of pH of plaques reaches its greatest intensity during the first thirty minutes after ingestion of glucose and is gradually overcome until little of the effect remains after two or three hours suggests that only by the repeated renewal of carbohydrate can the caries process remain active.

## CONCLUSIONS

The pH of plaques and open cavities may be lowered by the ingestion of certain carbohydrates.

These pH changes can be demonstrated directly in the mouth with the antimony electrode.

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# BACTERIOLOGIC VERIFICATION OF ROENTGENOGRAPHIC FINDINGS IN PULP INVOLVED TEETH

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ONE of the greatest weaknesses in the field of operative dentistry today lies in errors in diagnosis and the unwarranted sacrifice of teeth because of misinterpretation of roentgenographic evidence. The all too prevalent concept of many practitioners that every radiolucent area about the periapical region of a tooth constitutes a definite indication of infection is wholly unsupported by factual evidence.

Roentgenographic technic and interpretation, even in the hands of fairly skilful operators, in no sense measure up to a bacterial culture in accuracy or sensitivity. Furthermore, many factors may be involved in determining the exact status of the circulation of the blood within a tooth. It should be remembered that the capillaries of the pulp tissue are terminal endings of the dental artery supplying it. Any injury to the tooth as a result of disease or dental operative procedure will, in turn, be transmitted through the dentinal tubules to the pulp tissue and its capillaries.

If bacteria have invaded the pulp, the blood in the capillaries may carry bacterial products out into the general circulation for a time before an actual breakdown of the capillary wall takes place. Consequently, a vital infected pulp may act as a source of systemic infection or allergic reaction before it can be recognized as such by any pulp tests or roentgenographic evidence of periapical disturbance.

Since the periapical regions of bone are liable to changes in architecture as a result of circulatory disturbance within the dental pulp, it would be helpful if, from their roentgenographic appearance, it were possible to determine the pres-

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ence of organisms responsible for these changes, without sacrificing the tooth in the effort.

To understand the significance of various types of radiolucent and radiopaque shadows around root ends, we must first be familiar with normal variations in bone architecture. Simpson describes seven characteristic forms of normal trabecular arrangement, ranging from alveolar bone with abundant uniform cancellated areas and exceptionally small medullary spaces to alveolar bone in which the trabeculae are widely separated by large medullary spaces. It is quite obvious that a given roentgen exposure would, in the first type of bone, have to penetrate an area of greater density per unit, and consequently would register with a lighter index of illumination on the photographic negative than would be obtainable in a bone with large medullary spaces and thin trabeculae. Furthermore, the degree of radiolucency in bone of loosely woven architecture may be far greater than that found in beginning bone resorption, in a type having heavy trabeculae and small medullary spaces.

Table 1.—Periapical Bone Lesions Caused by Streptococcus Viridans

| Reg. No. | Roentgenographic Diagnosis | Etiology | Vitality | Tooth No. | Systemic Involvement |
|---|---|---|---|---|---|
| 3653 | Granuloma | Caries | − | 9 | None |
| 3724 | Granuloma | Caries | − | 7 | None |
| 3411 | Granuloma | Caries | − | 24 | None |
| 6472 | Normal | Caries | + | 13 | None |
| 3909 | Normal | Caries | + | 20 | None |
| 4840 | Normal | Caries | − | 20 | None |
| 3615 | Chronic proliferative osteitis | Blow | − | 8 | None |
| 6045 | Chronic alveolar abscess | Caries | − | 8 | None |
| 3189 | Chronic alveolar abscess | Metal filling | − | 6 | None |
| 3416 | Chronic proliferative osteitis | Metal filling | − | 7 | None |
| 3416 | Chronic circumscribed osteitis | Caries | − | 10 | None |
| 3618 | Chronic proliferative osteitis | Silicate filling | − | 9 | Acne on face |
| 3618 | Chronic proliferative osteitis | Silicate filling | − | 10 | Acne on face |
| 7196 | Chronic circumscribed osteitis | Caries | − | 7 | None |
| 3653 | Granuloma | Caries | − | 9 | None |
| 1667 | Radicular cyst | Caries | − | 6 | Rheumatoid arthritis |
| 1667 | Radicular cyst | Caries | − | 7 | Rheumatoid arthritis |
| 3724 | Granuloma | Caries | − | 7 | None |
| Sp199 | Chronic alveolar abscess | Blow | − | 8 | None |
| 3263 | Chronic alveolar abscess | Caries | + | 6 | None |
| 3766 | Chronic circumscribed osteitis | Silicate filling | − | 9 | None |
| 3602 | Chronic circumscribed osteitis | Metal filling | − | 6 | None |
| Sp500 | Chronic proliferative osteitis | Silicate filling | − | 8 | None |

### FACTORS IN BONE RESORPTION

Resorption of bone, such as is frequently found in the periapical region of teeth in which pulp disturbance has occurred, can have various causes. For a better understanding of the mechanism of resorption, attention is drawn to some facts concerning bone changes as laid down by Dr. Greig,[2] of Edinburgh, Scotland:

1. Maintain the circulation within certain limits and bone remains unchanged.
2. Produce a definite hyperaemia and bone undergoes rarefaction, decalcification and osteoporosis.
3. Restrict the blood supply and bone undergoes consolidation, increased density and osteosclerosis.
4. Cut off the blood supply and bone undergoes necrosis.

These facts have been well substantiated by the excellent work of Harold Keith Box,[3] of Toronto, Canada, in which he demonstrated extensive resorption of trabeculae on the side facing red bone marrow rich in red blood cells and no resorption of the same trabeculae on the side facing yellow or fatty marrow.

Box sectioned 100 blocks of tissue removed from human jaws to determine the frequency of distribution of red bone marrow. Yellow bone marrow was noted in seventy-five blocks. Definite zones of red bone marrow were present in twenty blocks in all age groups from 25 to 65 years. In the majority of cases, the presence of red marrow appeared to be focal in nature and the zones varied greatly in extent. Several examples were found in and above the maxillary tuberosity. Other examples were noted in the bone around upper and lower molars and bicuspids. One example was seen in the bone associated with an upper cuspid, but no examples were found around the upper or lower lateral and central incisors.

Box suggests that certain zones of rarefaction as revealed in roentgenograms of the jaws, diagnosed as chronic osteitis and known as so-called "residual infection," may be found to be adaptive enlargements of the medullary cavities to accommodate the proliferated and expanded marrow.

A similar condition is frequently encountered in periapical resorption of bone following the removal of a preexisting hyperemic pulp or in which certain forms of iodine have been employed in treatment. It is not uncommon to find a tooth in which the periapical tissue appears perfectly normal prior to pulpectomy or treatment, and, at the time that the final x-ray film is taken, after filling of the canals, to find definite evidence of bone resorption, without infection having been demonstrated.

Leriche and Policard,[4] probably recognized as the leading authorities on bone metabolism, point out that bone resorption may occur by osteolysis, a process by which the phosphocalcareous complex disappears without participation of cells in the process. The bone simply "breaks down," leaving connective tissue framework in its place. On the other hand, bone resorption may be caused by osteoclasis, in which the existing bone cells may be converted into phagocytic cells, the osteoclasts. These authors also point out the signs of bone resorption as follows:

(a) 1. Peripheral resorption of trabeculae.
2. Enlargement of medullary spaces (spongy bone).
3. Enlargement of Haversian canals (compact bone).
4. Presence of osteoclasts.
(b) The macroscopic signs of bone resorption.
1. Bone becomes softened.

Table 2.—Periapical Bone Lesions Caused by Variety of Organisms

| Reg. No. | Roentgenographic Diagnosis | Etiology | Vitality | Tooth No. |
|---|---|---|---|---|
| 4853 | Chronic alveolar abscess | Caries | − | 14 |
| 4242 | Chronic alveolar abscess | Caries | − | 7 |
| 4836 | Chronic proliferative osteitis | Metal filling | − | 6 |
| 7519 | Chronic alveolar abscess | Metal filling | − | 8 |
| 7519 | Chronic alveolar abscess | Silicate filling | − | 7 |
| 7519 | Chronic alveolar abscess | Metal filling | − | 10 |
| 6197 | Chronic alveolar abscess | Caries | − | 22 |
| 3615 | Normal | Caries | + | 3 |
| 4865 | Normal | Caries | + | 3 |
| 3189 | Normal | Caries | − | 11 |
| 5782 | Normal | Caries | + | 19 |

2. Bone bleeds easily at cut surfaces.

(These signs become particularly apparent during root resection.)

(c) Radiographic signs of bone resorption.

1. Increased radiolucency due to decreased density.

2. Loss of characteristic trabecular architecture.

In order to translate the roentgenographic signs of bone resorption into understandable clinical terms, we must establish, as far as possible, the etiologic factors, as to whether they are bacterial or arise from a preexisting hyperemic state. This problem has been under investigation for some time. In 1924, Haden[5] made cultures of the periapical tissue of 1,307 extracted vital and pulpless teeth and compared the findings with the roentgenograms. His method of culture involved an attempt to sterilize the field with tincture of iodine, followed by alcohol, with subsequent extraction of the tooth. Clinical experience has shown that this method not only invites contamination from the gingival crevice and soft tissue débris adhering to the root surface, but also is impractical, since it necessitates sacrificing the tooth itself.

Necropsy findings seldom benefit the patient. Furthermore, it has been demonstrated that the pumping action attendant on extraction will result in positive cultures routinely. Okell and Elliot[6] made observations on 138 patients with both septic and clean mouths. In these cases, 10 cc. of intravenous blood was taken immediately before and within five minutes after extraction. Of these cases, eighty-four showed a transient bacteriemia (the anhemolytic streptococcus) after extraction. The occurrence and degree of bacteriemia depended on the severity of gingival disease present and the amount of damage inflicted during the operation. In ten cases in which a positive blood culture was obtained immediately after extraction, a third culture, taken from ten minutes to eight hours later, was always negative.

Haden found that the incidence of infection is about as high in the roentgenographically negative as in the positive teeth; that there is a sharp limitation in the translation of roentgenographic evidence of infection into terms of bacteria, and that the absence of roentgenographic evidence of infection at the apex of a

TABLE 3.—PERIAPICAL BONE LESIONS CAUSED BY ANHEMOLYTIC STREPTOCOCCUS

| Reg. No. | Roentgenographic Diagnosis | Etiology | Vitality | Tooth No. | Systemic Involvement |
|---|---|---|---|---|---|
| 6138 | Radicular cyst | Metal filling | — | 8 | Acute infection |
| 7522 | Chronic circumscribed osteitis | Caries | — | 24 | None |
| 7421 | Chronic circumscribed osteitis | Caries | — | 10 | None |
| 3439 | Chronic proliferative osteitis | Blow | — | 8 | Erysipelas |
| 4310 | Chronic proliferative osteitis | Blow | — | 24 | — |
| 6469 | Chronic alveolar abscess | Old root filling | — | 10 | None |
| 7623 | Chronic alveolar abscess | Caries | — | 9 | Malaise |
| 5201 | Chronic proliferative osteitis | Caries | — | 10 | Acute nasopharyngitis |
| 2901 | Chronic alveolar abscess | Old root filling | — | 4 | None |
| 3928 | Chronic alveolar abscess | Caries | — | 24 | Frequent headaches |
| 3928 | Chronic alveolar abscess | Caries | — | 25 | Frequent headaches |
| 7876 | Chronic proliferative osteitis | Metal filling | — | 7 | Chronic colds |
| 3766 | Chronic proliferative osteitis | Blow | — | 7 | None |
| 4559 | Chronic proliferative osteitis | Blow | — | 6 | None |
| 4717 | Chronic alveolar abscess | Metal filling | + | 7 | None |

TABLE 4.—RELATIONSHIP OF ROENTGENOGRAPHIC DIAGNOSIS TO BACTERIOLOGIC FINDINGS

| Roentgenographic Diagnosis | No. of Cases | Bacteriologic Findings | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Negative | Anhemolytic Streptococcus | Streptococcus Viridans | Streptococcus Hemolyticus | Streptococcus | Staphylococcus Albus | B. Acidophilus | B. Acidophilus & Streptococcus Viridans | Variety of Organisms |
| Chronic alveolar abscess | 45 | 20 | 6 | 6 | 0 | 4 | 0 | 0 | 3 | 6 |
| Granuloma | 14 | 10 | 0 | 3 | 0 | 1 | 0 | 0 | 0 | 0 |
| Chronic proliferating osteitis | 22 | 6 | 6 | 5 | 0 | 2 | 1 | 0 | 1 | 1 |
| Chronic circumscribed osteitis | 15 | 5 | 2 | 4 | 1 | 2 | 0 | 0 | 1 | 0 |
| Cyst | 4 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 0 | 0 |
| Negative | 64 | 40 | 14 | 3 | 1 | 2 | 0 | 1 | 0 | 4 |

pulpless tooth never excludes the presence of active infection.

Cramer and Reith[6] cultured 200 freshly extracted pulpless teeth and came to the following conclusions:

1. Granulomas are invariably infected.
2. Apical areas about roentgenographically positive teeth are probably invariably infected.
3. Teeth with slight periapical change are infected to a less degree than those with more pronounced pathosis, and further classification may be possible.
4. Teeth definitely negative roentgenographically are infected only occasionally.

Fuendling, M. J., and Cartney, T. L.,[8] studied the roentgenographic records of vital pulp infection as confirmed by bacteriologic examination. They concluded that chronic infection of vital pulp tissue can be diagnosed from the dental roentgenogram.

Ennis[9] speaks of periapical lesions and their causative factors as follows:

If the streptococcus is of the hemolytic type of high virulence, and the resistance of the patient is low, the inflammation will be acute and may result in acute abscess formation. If this does occur, with evacuation of the pus under proper treatment, the condition may rapidly subside, with practically no detachment or destruction of the alveolodental periosteum, and no appreciable destruction of bone.

In case the invading organism is of the viridans type, of low virulence, the inflammatory reaction is apt to be chronic, giving rise to little apparent disturbance, but slowly progressive and proliferative in nature. The first change seen in the alveolodental periosteum is a thickening of this tissue, which is infiltrated with various blood elements, but especially polymorphonuclear and small round cells, particularly the latter.

In Table 1 of our studies showing the periapical bone lesions caused by *Streptococcus viridans,* we have found the organism present at every stage of bone disease, from the cases that appear roentgenographically normal, to and including radicular cysts.

In Table 3, it will be seen that *Streptococcus hemolyticus* occurs very rarely. In 174 cases, this organism was found only twice.

Arnett and Ennis[10] made a study of dental roentgenograms in connection with the past history and physical examination of 800 college students, in which they demonstrated no relation between periapical infection and any particular disease entity. These authors assumed that all periapical radiolucent areas were infected.

*tococcus viridans* constituted only 8.3 per cent of the organisms of all the positive visceral cultures, but 62 per cent of those of the periapical cultures. *Streptococcus viridans* is found with greater frequency in periapical regions than in alveolar marrow or the abdominal viscera. Negative cultures were obtained in all instances when the apex was not reached. Burket fails to specify the nature of the canal contents in these instances. His results in cultures made deliberately from the alveolar bone marrow were negative

TABLE 5.—RELATIONSHIP OF ROENTGENOGRAPHIC DIAGNOSIS TO BACTERIOLOGIC AND VITALITY FINDINGS

| Roentgenographic Diagnosis | No. of Cases | Bacteriologic Findings | | | |
|---|---|---|---|---|---|
| | | Negative | Vitality | Positive | Vitality |
| Chronic alveolar abscess | 45 | 20 | Vital 5<br>Non-vital 15 | 25 | Vital 3<br>Non-vital 22 |
| Granuloma | 14 | 10 | Vital 0<br>Non-vital 10 | 4 | Vital 0<br>Non-vital 4 |
| Chronic proliferating osteitis | 22 | 6 | Vital 1<br>Non-vital 5 | 16 | Vital 0<br>Non-vital 16 |
| Chronic circumscribed osteitis | 15 | 5 | Vital 1<br>Non-vital 4 | 10 | Vital 5<br>Non-vital 5 |
| Cyst | 4 | 0 | Vital 0<br>Non-vital 0 | 4 | Vital 0<br>Non-vital 4 |
| Negative | 64 | 40 | Vital 26<br>Non-vital 14<br>40 | 24 | Vital 22<br>Non-vital 2<br>24 |

L. W. Burket[11] made cultures from 419 periapical areas in cadavers of persons between the ages of 20 and 50. This age group corresponds to that covered in this survey. Of this number, he found that 206, or 49 per cent, contained organisms. Cultures of an average of four periapical areas were made in each case, in addition to examinations of the alveolar marrow. Comparison was also made between the frequency with which the organisms occurred in the viscera, including the liver, kidneys and spleen, and in the periapical region in the same case. *Strep-* in thirty-four of thirty-five cases examined. This supports the view that the cementum covering the root surfaces acts as an impenetrable barrier, preventing the passage of any foreign material in either direction.

Burket grouped teeth as follows:

1. Non-carious: Teeth with no clinical evidence of caries, 92.
2. Carious: Teeth in which caries was present with no evidence of pulp exposure, 144.
3. Restorations: Teeth in which restorations had been made, 115.
4. Exposures: Teeth in which the pulp

chambers were in communication with the oral cavity, 50.

5. Pulpless: . . .

It was found that there was a definite decrease in the percentage of pure cultures and an increase in the size of periapical radiolucent areas. In no case was *Streptococcus viridans* cultured from the alveolar bone marrow. A higher percentage of pure cultures was obtained from the periapically roentgenographically negative teeth than from those with apical roentgenographic changes. The frequency of mixed cultures increased with the development and increase in size of the periapical roentgenographic lesions. This, of course, is to be expected because, as the lesion becomes chronic and is long existent, the tendency to mixed infections is apt to increase.

Frankel[12] analyzed the dental and systemic findings in 19,000 persons insured by the Metropolitan Life Insurance Company and found no correlation between any systemic disturbance and the extent of dental restorations.

Herman Osgood[13] states that the type of reaction as seen in the roentgenogram will indicate in general whether the patient's resistance to infection is high or low. The granuloma occurs more commonly in young adults whose resistance is high; whereas the blind or chronic abscess with scar bone reaction occurs more commonly in persons of lowered resistance.

## ROENTGENOGRAPHIC TECHNIC OF OUR STUDIES

Since the purpose of this survey is primarily to correlate the clinical bacteriologic data with the actual roentgenographic findings of various types of periapical lesions, it is necessary that accurately timed and processed roentgenograms be obtained under strictly standardized conditions. In all our clinical cases, Eastman regular films were used throughout, exposed with a standard Ritter dental air cooled tube operating at 10 milliamperes and 45,000 volts. Wherever errors in exposure or angulation resulted in failure to reveal clear-cut bone structure, retakes ruled out any possible misinterpretation.

## ROENTGENOGRAPHIC INTERPRETATION

Cases were considered normal wherever the periodontal membrane and *lamina dura* appeared undisturbed. The surrounding bone was considered normal wherever the trabeculae and cancellated areas had uniform distribution for the particular age of the patient. This, of course, varied from large cancellated areas in young individuals to very small ones with thick trabeculae in those of middle age.

Vital degenerating pulps, although occasionally recognized by means of a halo of radiolucency in the periapical region, were not considered as such in the present study. The acute alveolar abscess, when seen in its early stages, may be practically invisible or may give the cancellous bone a somewhat cloudy appearance. Since these cases seldom reach the postgraduate clinic at their inception, they are usually seen after proliferation of the periodontal membrane has taken place.

The chronic alveolar abscess, sometimes referred to as chronic rarefying osteitis, shows advanced thickening or destruction of the periodontal membrane with localized resorption of the approximating trabeculae. Care should be exercised not to misinterpret as normal bone the enlarged marrow spaces arising from trabecular resorption.

Granulomas, being connective tissue tumors of more or less definite outline, are simply a more advanced stage of the chronic alveolar abscess, there being no sharp line of demarcation between the two. The well-advanced type of granuloma may further be mistaken for the chronic circumscribed area of osteitis, in which, although there is a resemblance to the granuloma in appearance at times,

the bone is not replaced by connective tissue. One is frequently impressed with this fact when, on resecting the involved tissue, it is found that the roentgenographic interpretation does not correspond to the clinical findings.

The chronic proliferative type of osteitis, sometimes called chronic rarefying osteitis with suppuration, is usually indicated by a well-advanced radiolucent area with poorly defined outlines. They appear darker in the region of the root tip and gradually fade into the surrounding normal bone. Upon resection, the amount of bone involved is invariably far more extensive than the roentgenogram seems to indicate.

The cyst, in contradistinction to the area of chronic proliferative osteitis, presents a well-defined area of fairly uniform radiolucency, more than three-eighths inch in diameter. At certain stages, however, what appears to be a cyst will actually prove to be an area of advanced suppurative osteitis.

### ELECTRIC VITALITY TESTS

It should be remembered that the electric vitality tests merely record nerve irritability of the fibers within the pulp tissue, giving no accurate information as to the status of the circulatory elements. Because of its fat content, nerve tissue is more highly resistant to extrinsic injurious agents than are the delicate endothelial cells forming the fine pulp capillaries. Therefore, the first change that occurs whenever a pulp is subjected to an injury, such as caries, trauma or instrumentation, is a disturbance in the circulatory elements, together with the usual degenerative changes, manifested in the form of calcium deposits throughout the structure of the pulp tissue. A breakdown of the delicate capillaries occurs long before the resistant nerve fibers have ceased to function.

Although the electric vitality test gives a rough indication of nerve response to stimuli, it does not indicate what is occurring within the blood vessels themselves, which, after all, are the actual conveyors of injurious agents responsible for changes in the periapical bone structure, whether they are bacterial toxins, protein poisons or waste products resulting from tissue stagnation.

Thoma[14] described a vital pulp as follows: "As long as metabolism takes place, we may speak of the pulp as vital, but at the same time it may be diseased, just as a person may be alive and at the same time sick."

In thermal tests, it was found that the time required for sensation reaction in changing from hot to cold was shorter than when either heat or cold is used alone. Because of the many uncontrollable errors involved in tests to determine the variable thermal capacity of teeth with or without pulp recession under restorations we have come to regard thermal tests, generally, with misgivings.

In the survey here reported, all available means of determining actual vitality were employed. Cases listed as vital must be regarded as such within the present limits of diagnostic methods at our disposal. From the many positive cultures obtained from vital pulps, it is obvious that so-called vitality as an indication of health of the pulp is a somewhat misleading term, since it in no sense indicates the actual degree of infection that is being carried by the capillaries within the confines of the pulp chamber or canal.

### CULTURE TECHNIC

All the cases reported in this survey were of teeth clinically treated and the strategic importance of which warranted retention. Cultures were made in every case *in situ* through the canal, as follows: After placement of a rubber dam, a field of operation comparable to the size of the rubber dam frame was sterilized with 7 per cent tincture of iodine, followed with a 95 per cent alcohol wash. Access to the pulp chamber was had by

means of a sterile bur. If a roentgenographically negative vital pulp was to be removed and cultures were to be made, care was exercised to go only to the dentinal-cemental junction with small 1, 2 and 3 files accurately marked for length. The files were passed to the junction solely to expedite the use of barbed broaches for pulp extirpation. Immediately after pulp removal, a culture of the moist canal was made by passing a sterile J & J point to the canal and allowing it to remain until well moistened, and then inoculating a tube of beef infusion, ascitic fluid, semi-solid medium.

If a roentgenographically positive pulpless tooth was to be cultured, access to the lesion was had as before, with care to pass the marked files just to the lesion in order to gather sufficient inoculum on the J & J point for culture. Because of the varying amounts of stagnant tissue débris in the canal, care should be exercised not to carry foreign material into the periapical tissues in order to avoid an exacerbation. In addition to inoculating two tubes of culture media, direct smears were made.

All of the foregoing technic was carried out under strictly aseptic conditions.

### METHOD OF TREATING CANALS

A brief discussion of our methods of treatment may suffice to supplement the explanation as to the methods employed in taking cultures of teeth. In our school clinic, vital teeth of strategic importance which show normal periapical tissues, but in which the clinical crown has suffered a pulp involvement through caries, trauma or instrumentation, are treated by routine therapeutic methods that have proved highly successful during the past fifteen years. All carious cavities are carefully excavated and a dressing of eugenol is sealed in contact with sound dentin for at least twenty-four hours before pulpectomy is contemplated. Teeth in which proximal cavities exist are carefully fitted with an accurately contoured copper band, which is cemented to the crown during the entire period of treatment in order to avoid any possible contamination through seepage of saliva.

After placement of the rubber dam, the entire field of operation, comparable in size to the outline of the rubber dam frame, is thoroughly sterilized with a 7 per cent tincture of iodine followed by a 95 per cent alcohol wash. Opening to the pulp chamber is made with a sterile spade bur. Teeth from which a vital pulp is to be removed are accurately measured for distance from the crown to the dentinocemental junction. This length is recorded on the history chart for future reference. After removal of the pulp, the canal moisture is absorbed on sterile J & J points, by which inoculation is made into the culture tubes. Essential oils, such as eugenol, oil of cloves or a mixture of iodine and glycerine, are then sealed in the canal.

In order to be sure that the drug used in the preceding treatment will not obscure a possible positive culture, an experiment was made in which the drug points which had been sealed in the canals for forty-eight hours were employed to inoculate the culture media at the same time that a new paper point was cultured in the routine manner. The variation in result was insignificant.

A further check is also made by making two sets of cultures in each case. In sealing the first treatment point, a pellet of cotton is placed over the dressing, followed by a seal of temporary stopping, which is carefully burnished against the walls of the pulp chamber. This primary seal is coated with sandarac varnish. A creamy sticky mix of petroid cement is then used as the final seal.

The patient returns for the second treatment after forty-eight hours, when the culture report is ready. The rubber dam is again placed; the field is sterilized as before, and an opening through the cement seal is made with a sterile bur until the primary gutta-percha seal

is reached. This is carefully removed with a sterile spoon excavator or explorer, and the dressing is removed. A second culture is made and, if the first cultures have shown a growth, a suitable germicide is sealed in, preceded by a thorough washing of the canal with trichlor or physiologic sodium chloride solution to remove any vestige of débris. In this way, the treatment drug is not dissipated by absorption into pulp débris or dentin filings, but comes in direct and intimate contact with the entrance to the dentinal tubules and their contents. Cultures are taken until two negatives are obtained in sequence. In the majority of instances, this is accomplished in three or four treatments.

Cases showing progressive destruction of the periapical bone are managed in a manner similar to that just described except that, prior to sealing the canals, the dentinal surface is treated with a concentrated solution of dehydrated phenol sulfonic acid, followed by neutralization with sodium bicarbonate and water. Owing to its high affinity for moisture, the acid removes from the dentinal tubules whatever foreign matter may have remained. After the sterile canals have been hermetically sealed, the apex and the surrounding tissue are removed surgically in every case of advanced bone destruction. The result is comparable to what could have been accomplished by extraction except that an important masticatory organ has not been sacrificed.

Return of the periapical tissues to their respective state of normalcy has been found to occur in the great majority of cases, as shown by Hatton,[15, 16] Kronfeld,[17] Coolidge and others in histologic sections of bone and teeth so treated.

In exceptional cases, when extensive periapical destruction has already occurred, it is impossible to render the canal sterile by ordinary therapeutic methods. We have found, however, that several successive treatments will show a sufficient decrease in the number of organisms previously present that resection can be satisfactorily performed by the use of dehydrated phenol sulfonic acid just prior to filling the canal. In the great majority of cases listed in this survey, the patients were between 18 and 30 years and the roots were resected immediately after sterility was assured by the negative cultures.

## RESULTS

This survey includes 174 cultures of pulp-involved teeth in ambulatory patients ranging in age from 18 to 35 who were under treatment in our root-surgery clinic. The purpose of this study was to determine how the roentgenographic diagnosis agreed with the actual bacteriologic cultures obtained from such teeth *in situ,* and their possible relationship to any systemic complaint that may have been present. An attempt was also made to evaluate the pulp vitality tests. A thorough physical diagnosis of the general health was recorded on a history chart in every case. The etiologic factor responsible for the pulp involvement was carefully recorded as far as it could be determined clinically or from the patient's history. Negative cultures were obtained from all types of roentgenographic lesions. It should also be noted that positive cultures were obtained from teeth which appeared roentgenographically normal.

Of the positive cases, it can be seen that cases from which *Streptococcus viridans* was isolated varied from perfectly normal parodontal membranes down through every stage of bone change, to and including the radicular cyst. There was no evidence of selectivity as to the type of bone lesion produced or to its extent. Furthermore, *Streptococcus viridans* was isolated from vital pulps as well as those found to be non-vital. Of twenty-seven cases yielding *Streptococcus viridans* on culture, only two gave a history of systemic complaint, one being

rheumatoid arthritis and the other acne of the face. The actual correlation of the organism to the systemic complaint is highly problematical.

The etiologic factors in pulp involvement in these cases varied from carious exposures to all types of restorations. In Table 2, eleven cases yielded cultures containing a variety of organisms. The etiologic factor in seven of the eleven cases was carious exposure. The possibility of mouth contamination through the carious lesion undoubtedly accounts for this variability.

The majority of the cases appeared roentgenographically normal. Table 3 lists fifteen cases from which the anhemolytic streptococcus was isolated, of which seven gave a history of systemic involvement. All cases showed roentgenographic evidence of advanced bone disease and in no case was the anhemolytic streptococcus isolated from a tooth that appeared roentgenographically normal, or one having a granuloma present. This fact should be of some clinical significance in the consideration of well-advanced lesions with a history of systemic involvement. There is no specificity as to the type or extent of the lesion associated with anhemolytic streptococci, although, in every instance, the lesion was chronic and well advanced and involved considerable tissue.

In Table 3, we also find that in all cases examined, *Streptococcus hemolyticus* was found only twice, once in an apparently normal vital tooth and once in the presence of a chronic circumscribed osteitis. In neither case was there a systemic involvement. This is particularly significant in view of the well-known virulence of this group of organisms and the fact that *Streptococcus hemolyticus* is generally believed, in many instances, to be the organism responsible for the infectious forms of arthritis. In the arthritic clinic at the University of Michigan, Dr. Freyburg attributes little if any significance to *Streptococcus hemolyticus* as an etiologic factor in infectious arthritis. The rarity of this organism in the teeth should be borne in mind whenever the dental condition is looked upon as a possible factor in arthritis.

Pemberton[20] writes: "The day is past when in the presence of refractory arthritis, an important tooth should be sacrificed merely because it is not vital."

Table 5 shows the relationship between vitality tests, bacteriologic cultures and roentgenographic findings. It will be noted that of forty-five cases which appeared as chronic alveolar abscesses, twenty were bacteriologically negative and of these five were vital. These five cases would indicate that although periapical changes had progressed as a result of circulatory disturbances within the pulp, the nerve fibers were still capable of registering irritability.

Of fourteen cases diagnosed roentgenographically as granulomas, ten were found to be negative and four positive. All cases were non-vital. This finding is contrary to the general belief that all granulomas are infected.

Of twenty-two cases diagnosed roentgenographically as chronic proliferating osteitis, six were negative and sixteen positive; and of the total number, only one was reported vital. This vitality, which is contrary to what one would expect in a well-advanced lesion, may have been due to an error in recording vitality.

Of fifteen cases diagnosed roentgenographically as chronic circumscribed osteitis, five were negative and ten positive, and, of the total number, six cases gave a positive vitality response. This again demonstrates that roentgenographically positive teeth frequently give a negative pulp vitality response.

Of four cases diagnosed roentgenographically as cysts, all were infected and were non-vital on test.

Of sixty-four cases diagnosed as roentgenographically negative, forty were bacteriologically negative and twenty-four positive. Of the forty that were bac-

teriologically negative, twenty-six were vital and fourteen non-vital. Of the twenty-four that were bacteriologically positive, twenty-two were vital teeth and only two were non-vital.

From this, it will be seen that there is no relationship between the roentgenographic appearance of a tooth and its bacteriologic content or the state of its circulatory elements.

## CONCLUSIONS

1. It has been pointed out that many types of bone characteristics which appear to be abnormal may be normal for certain individuals or for certain specific regions and so may not necessarily indicate the presence of infection.

2. As bacteriologic findings do not wholly confirm the roentgenographic appearance of periapical lesions, too much emphasis should not be placed on the roentgenogram as a diagnostic agent in condemning questionable teeth.

3. Owing to the variability of organisms found in different lesions, it is not possible to correlate the periapical disturbance and the specific organism possibly responsible for it.

4. In view of the rarity of proved cases of systemic involvement associated with teeth that appear roentgenographically and bacteriologically positive, there is considerable question as to the importance of the pulp-involved tooth as a focus of infection.

5. Vitality responses do not coincide with either roentgenographic or bacteriologic findings.

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# FRACTURES OF THE MANDIBLE
## A STATISTICAL STUDY OF ONE HUNDRED CASES

By JOSEPH A. DOHERTY,* D.M.D., B.S., M.S., Boston, Mass.

THE purpose of the present investigation was to obtain data pertaining to fractures involving the lower jaw and to make comparison whenever possible with the findings recorded by others in similar studies. Because of the frequency of fracture of the mandible, it might be supposed that many similar analyses had been made. A review of the literature, however, reveals a relatively small number. In 1915, Dunning studied a series of 1,065 cases; in 1926, Ivy and Curtis, 100; in 1928, Reiter, fifty; in 1930, Dean, fifty, and in 1934, Winter, 200. This study is based on 100 cases treated at the Massachusetts General Hospital. Although these were not consecutive cases, no special means of selection was employed. Fracture in every case resulted from the application of force. Attention is directed to the most important observations.

### CLASSIFICATION OF DATA

The data were classified under (1) etiology, (2) location, (3) type of fracture (single, double or multiple), (4) period of immobilization, (5) age and sex, (6) method of fixation and (7) end-result.

### ETIOLOGY

As to the etiology of these injuries, it is obvious that in civilian life the factors would be quite varied. The most common cause of fracture was a blow, 47 per cent of cases comprising this group. Seventeen persons (17 per cent), suffered injuries from falls, which ranged from stumbling down a few steps to a drop from the second story of a dwelling. Eight per cent were occasioned by automobile accidents. In only one case was the removal of a tooth the etiologic factor. In the remaining seventeen cases, there were miscellaneous causes, such as being crushed by logs, wounded by a rifle or kicked by a pony. In Dunning's series, the small group of persons suffering automobile injuries may be accounted for by the fact that these cases occurred between the years 1906 and 1913, when motorized transportation was in its infancy.

TABLE 1.—ETIOLOGY

| | Per Cent | | |
|---|---|---|---|
| | Massachusetts General Hospital | Ivy | Dunning |
| Blows | 47 | 49 | 46.5 |
| Falls | 17 | 14 | 13.0 |
| Sports | 10 | 3 | 2.1 |
| Auto | 8 | 8 | 0.2 |
| Removal of teeth | 1 | 5 | 0.5 |
| Miscellaneous | 17 | 21 | 37.7 |

### LOCATION

In this series, 66 per cent of the fractures were single; 31 per cent, double, and 2 per cent, triple. In one case, bilateral fracture of the condyles was accompanied by injury to the symphysis and mental foramen region. The most frequent site of single fracture was found to be at or near the angle, 48 per cent occurring in this area. The next most

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common location was in the region of the mental foramen. In the majority of bilateral cases, fracture occurred at the angle and in the mental foramen region. These findings are in accord with those of Ivy, Dean and Winter, but differ from those of Reiter, who reported the mental foramen region as the most common location. In this group, fracture of the symphysis occurred eighteen times. Involvement of the neck of the condyle is to be suspected in all cases of trauma in the region of the chin.

PERIOD OF IMMOBILIZATION

The time elapsing from the date of injury to that of fixation varied from a few hours to 21 days, the average being 6.4 days. Ivy and Winter reported 10.2 and 6 days, respectively. It has generally been believed that the period of immobilization of the jaws in an uncomplicated fracture is about five weeks. The results of this study and those of the other investigators tend to bear out this statement. Winter found 36 days necessary for union; Ivy, 31.5, and Dean, 43.2. A low average of 31.6 days was found in this group. The longer period in Dean's cases is accounted for by the fact that firm union was necessary, because his patients, who were seafaring men, returned to their ships immediately upon discharge from the hospital and started on long sea voyages. When a longer time than the foregoing averages is found essential for union, invariably the complications causing delayed osteogenesis are abscess formation and osteomyelitis.

Fig. 1.—Model showing Kazanjian button with intermaxillary elastics.

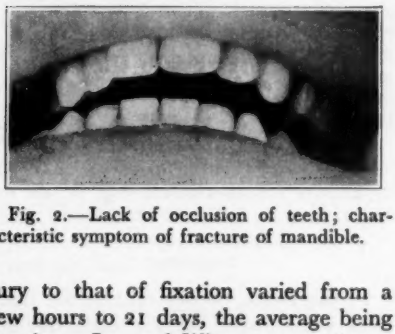

Fig. 2.—Lack of occlusion of teeth; characteristic symptom of fracture of mandible.

AGE AND SEX

In considering the age distribution, three divisions were formed, representing twenty-five-year periods in life. The youngest patient was 6 years of age, the oldest 78. Forty-two per cent of the cases occurred in the first division (1-25 years) and 51 per cent, in the second, the remaining 7 per cent being more than 50 years of age. These findings confirm the observations of other investigators. There is sufficient statistical evidence to justify the statement that the majority of fractures of the jaw occur between 20 and 45 years of age.

Fig. 3.—Reduction and immobilization of fractured mandible using buttons with intermaxillary elastic traction.

As would probably be expected, fracture in the male is of much greater frequency than in the female, only twelve cases in this series being in females. This figure is somewhat higher than those of Dunning, Reiter and Winter, who re-

ported 7, 8 and 7.5 per cent, respectively.

### METHOD OF FIXATION

Because of the diversity of the mechanical means utilized in the treatment of fractured jaws, direct comparison with the means employed in the different series is impossible. The ingenious minds of those who treat this type of bone injury have modified in various ways the basic method employed by the late Thomas L. Gilmer of Chicago.

An analysis of the methods used in this article reveals two facts of particular interest; namely, the small percentage of cases (six) in which special splints were employed and the wide use of elastic traction as a means of reduction. In this group, intermaxillary elastics, for the most part, have been used in conjunction with the wire buttons devised by V. H. Kazanjian. The value of elastic force is emphasized by the fact that fifty-two cases were treated by this method, and, in 64 per cent of the complete series, elastics were used entirely or as a supplementary means of fixation.

### SUMMARY

In one hundred cases of fracture of the mandible, the most common site of single fracture was at or near the angle of the jaw. Of the bilateral cases, almost one half occurred in the mental foramen region and at the angle of the opposite side.

Males were found to be more prone to this type of injury than females.

The average number of days of immobilization was 31.6.

Good end-results were obtained in all cases.

The results of this study do not vary to any appreciable extent from the findings obtained by others in similar investigations.

TABLE 2.—LOCATION

| | Complete Series Per Cent | | |
|---|---|---|---|
| | Massachusetts General Hospital | Ivy | Dunning |
| Single | 66 | 68 | 89.0 |
| Double | 31 | 31 | 10.0 |
| Multiple | 3 | 1 | .6 |

| | Single Fractures Per Cent | |
|---|---|---|
| | Massachusetts General Hospital | Ivy |
| Angle | 48.4 | 52.9 |
| Mental foramen | 30.3 | 30.8 |
| Symphysis | 15.1 | 8.8 |
| Condyle | 3.0 | 7.3 |
| Coronoid process | 3.0 | |

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# SOME IMPORTANT ASPECTS OF FIXED BRIDGE RESTORATIONS

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ONE of the basic principles of physiology is the coordination of bodily function. The organs of mastication function as a whole: affect in any way a single part, or a single function, and you affect in a greater or less degree every other function.

Slight disturbances may not demand recognition. They may even be accepted as part of the inescapable lot of man, who is resigned, in many instances, to minor disturbances. The loss of a lower first molar tooth may not, to any appreciable extent, affect the process of mastication. Nevertheless, the fact remains that if the edentulous space and occlusion are not maintained with an efficient space retainer during childhood, or by an adequate restoration when age and existing conditions permit, certain long recognized pathologic changes are inevitable.

When we endeavor to restore the function of mastication and occlusion after loss of a tooth or teeth, we are faced with the realization that the dental organs cannot be isolated as a separate and definite entity, but that the dental mechanism must be considered as one of the interdependent parts of the entire organism.

The practice of crown and bridge prosthesis has included many technics and procedures for replacing missing teeth. Some advances have resulted from seeking the causes of failure and making a conscientious effort to prevent its recurrence. Others have resulted from the newer knowledge of diagnosis and treatment planning and the introduction of biologic and physiologic phases of the subject.

The restoration of edentulous spaces by means of fixed bridges, by the ardent and almost universal application of mechanical principles to the restoration of mouth tissues, with a lack of consideration for the biologic, physiologic and hygienic requirements of the case, is now recognized as an outstanding error in prosthetic practice, recognition of which has brought about a readjustment of these mechanized procedures, which often resulted in pathologic conditions.

One of the challenging elements in dentistry today is the sharp scrutiny to which some of the old ideals and practices are being subjected. We no longer devitalize teeth to get more mechanical retention by means of dowels, or for anchorage in the root canals or pulp chambers; not because the principle of retention is mechanically wrong, but because we now know that, from a biologic standpoint, it is an unpardonable practice to devitalize a tooth in order to gain additional retention. Every abutment tooth must be carefully considered as to its biomechanical possibilities, if it is to be used for the support and retention of a fixed bridge. Maintenance of the vitality of the pulp, the health of the supporting tissues, a marginal safety to more than adequately withstand the stresses that will be imposed upon it and other factors in the life and health of the tissues involved must always receive due con-

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sideration. Nature's laws are not capable of or susceptible to change. We have learned from past experience that bridge restorations must conform to these laws or they will fail.

In order to obtain results that can be designated as successful, the restorative procedures must be founded upon recognized fundamentals, an intimate knowledge of the cause and effect of loss of the tooth or teeth and a shifting from the purely mechanical to the biomechanical aspect. The restoration must combine physiologic and biologic considerations, efficiency, permanency and stability, hygienic significance and esthetic unity.

A knowledge and correct application of the principles of dental physiology are of vital importance in the field of fixed bridge prosthesis. Its study is not limited to the teeth alone, but must include all the organs involved in the function of mastication: the osseous structures, the soft tissues, the temporomandibular articulation, the muscles of mastication and the tongue, lips and cheeks. We are aware of the significance of the function of mastication and its importance in determining the state of health or disease of the teeth and their supporting structures. Occlusion plays a most important part in the life and function of a bridge restoration and the investing tissues. Inharmonious or traumatic occlusion is now recognized as one of the outstanding causes of fixed bridge failures.

Efficiency is measured by the extent to which we capitalize on our knowledge of occlusion, function, form, design and construction and apply it to restorations. It is the duty of every dentist to avoid tongue annoyance, phonetic interference and unhygienic conditions; to protect the cheek, tongue and lips from injury, by means of establishing correct contours and proper axial relationships, and to prevent any other condition that is likely to annoy the patient or detract from the efficiency of the restoration.

This problem of permanence, which deals with the duration and degree of fixedness, is of vital importance; for a fixed bridge is of little or no value, and may be decidedly detrimental if it does not remain fixed. Permanency can be secured only by careful selection of abutment teeth and abutments, due consideration of their possibilities and limitations and the placement of fixed bridges where retention can be assured.

No study of the stresses that will be imposed, advanced treatment planning or skilled effort should be spared, in order to secure permanency and longevity, which can, at times, be secured only by sacrificing esthetic qualities to a greater or less degree. The popularity of some types of abutments is probably due to the ease with which they can be made, their esthetic possibilities and the desire to conserve tooth structure. Unfortunately, they do not possess the inherent qualities of retention and stability which are essential. The preparation of teeth for abutments must consist of more than a few slices, one or more short, misdirected pinholes, or shallow, inadequate grooves. On the other hand, the desire to avoid entirely the showing of gold has resulted in abutments that do not possess sufficient retention and stability to withstand the stresses imposed upon them.

### INLAY ABUTMENTS

Clinical observation and a study of fixed bridge failures, over a long period of time, have shown that the regular mesioclusal and mesioclusodistal inlays, in the majority of cases, are inefficient and short-lived. The irksomeness of making Class 2 inlay abutments with adequate retention is evidenced by these failures. It was at one time thought that, by breaking stress, this difficulty could be overcome; but tensile stress, tongue pressure, gravity and leverage exerted forces having a tendency to move the lug out of the lug seat, bending

the inlay at the pulpal-axial angle area so that the gingival margin was opened or the entire retaining abutment displaced. Barring those cases of poor judgment, short teeth or teeth weakened by caries, the use of gold alloys of inadequate or unknown physical properties, faulty technic, etc., we still have failures with the most favorable cases, as evidenced by loosening and the leaky gingival margins, especially in the area adjacent to the edentulous spaces.

The life of the mesioclusodistal inlay abutment can be greatly increased by limiting its use to one inlay abutment on a bridge when used with another abutment having more occlusal spread; by the careful selection of abutment teeth that are strong, of average or more than average length, with a sound intervening septum of dentin between the buccal and lingual walls, and by certain modifications in the preparation of the cavity. In the first place, the gingival seat should have adequate width buccolingually; otherwise, it will be necessary to provide occlusal extensions into the buccal and lingual surfaces. Grooves made in the bucco-axial and linguo-axial angles extending partially or the full length to the gingival seat will add materially to retention and stability. In addition, the developing of a gingival lock, by slanting a portion of the gingival wall rootwise, using gingival marginal trimmers to develop an acute angle at the junction of the axial and gingival walls, will tend to overcome displacement in the gingival area.

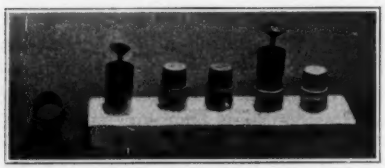

Fig. 1.—Dies made of rapidstone, castone, akaratex or diolite from wax pattern taken in copper band and packed by centrifugal force, permitting casting made to fit a B. of S. steel die to be only slightly seated.

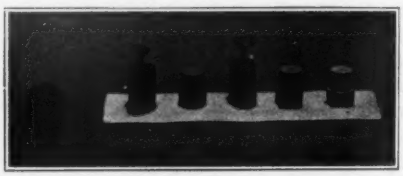

Fig. 2.—Dies made of rapidstone, castone, akaratex or diolite and packed in manner indicated in Figure 1, but with wax pattern taken and die made with wax pattern in brass ring, permitting same casting referred to in Figure 1 to be completely seated.

### THREE-QUARTER AND PARTIAL CROWN ABUTMENTS

On most bicuspid teeth, the three-quarter crown excels the mesioclusodistal inlay abutment; for it provides more retention, more extensive occlusal spread and more cusp protection, and has a shorter margin, with a greater portion under the free margin of the gum. Besides, the three-quarter or partial crown preparation can be made with less extensive cutting into the dentin.

The retentive features of all three-quarter and partial crowns must be accurately and definitely developed by means of parallel walls, and other means of anchorage in sound dentin, such as grooves, pins and dovetails. Short, small or tapering teeth and certain malformed and extensively decayed teeth on which adequate retention cannot be secured eliminate this form of abutment.

On anterior teeth, poorly fitted, weak castings with thin proximal surfaces and questionable non-parallel preparations result in carious areas along the incisal edge, in the proximogingival areas, or complete loosening of the abutment.

As an additional means of anchorage, the thickening of the casting in the cingulum area and the insertion of an iridioplatinum pin or screw, at right angles to the long axis of the tooth, have been

suggested, such anchorage being established after the abutment has been cemented to place.

Esthetically, the incisal protection for anterior teeth presents quite a problem. Too often, inadequate incisal protection results from the desire to prevent the showing of gold along the incisal edge. Since varying conditions such as the bite, incisal thickness and incisal stress must be met, the shaping, termination and the amount of incisal protection must be carefully considered and increased or minimized to provide sufficient bulk or strength to avoid yielding; a crushing or breaking down of cement under a thin layer of gold alloy; the wearing away of the gold, resulting in the exposure of margins, or the fracturing of the incisal edge of the natural tooth.

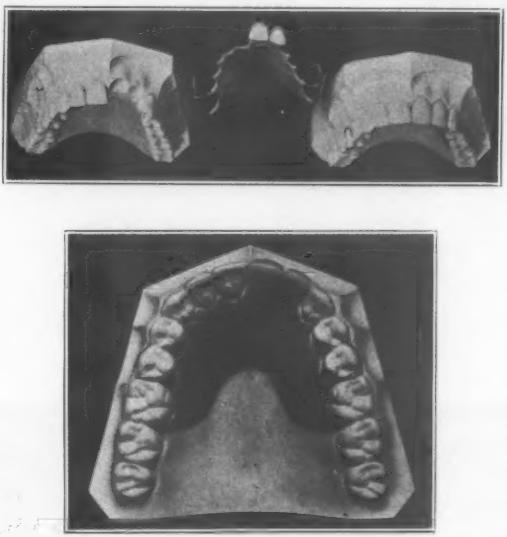

Fig. 3.—Partial denture with stainless steel wire clasps, which is placed immediately after extraction and worn until ridge is completely healed.

### FULL CAST GOLD CROWNS

Posterior teeth afford better opportunity and a greater range of possibility of securing adequate retention than do the anterior teeth, owing to size, shape and the decrease in esthetic demands. Have you ever removed a fixed bridge with two cast gold crown abutments? Here, we have maximum retention. When the abutment tooth, owing to caries, is in such condition that other types of abutments cannot be used; where maximum retention must be had, and where susceptibility to caries prevails, the gold crown provides the most efficient type of abutment. In the bicuspid region, and occasionally in the molar region, some of the modified types, such as the gold crown with porcelain veneer, may, from an esthetic standpoint, be used to advantage.

### FRICTIONAL RETENTION

Frictional retention plays a most important part in the permanency of the restoration. If the bridge abutment is too loose, too much dependence must be placed on the cement for retention. If it is too tight, there is danger of dentin com-

pression and pulp involvement. We have learned by experience that certain types of abutments, as well as the size, bulk, etc., determine the degree of expansion required, the gold crown requiring the most, while an anterior three-quarter crown with a similar amount of expansion would be overexpanded and consequently lack the required frictional retention. With controlled expansion by means of the setting and thermal expansion of the investment, thermal expansion of the wax and hygroscopic expansion of the investment, the degree of expansion necessary for abutments with the desired degree of frictional retention becomes merely a matter of technical procedure.

Whether the wax pattern is secured by the direct, indirect-direct or indirect method is more or less a matter of personal preference. Probably, the outstanding objection to the indirect technic is the possibility of securing an inaccurate impression. I believe that more accurate results are obtainable when the wax pattern is carved directly in the mouth, or by removing the wax pattern from the

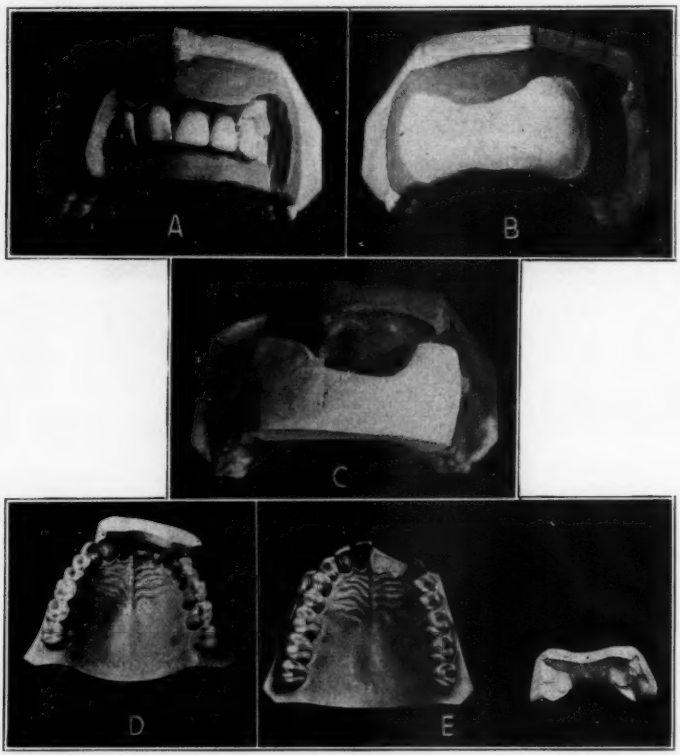


**Fig. 4.—First plaster matrix. A, clay formed on working cast for pouring of plaster. B, plaster poured into clay form. C, clay removed leaving gingival portion of facings exposed. D, plaster matrix in place holding facings with baked porcelain saddles in correct relation to ridge. E, plaster matrix removed, holding facings with baked saddles.**

die and readapting it to the cavity or preparation of the natural tooth prior to investing and casting.

In order to have wax patterns withdraw with the least amount of resistance, in all abutment teeth, the prepared area should be highly polished. This assures a wax pattern and a cast gold alloy abutment with extremely smooth surfaces. While this is most desirable for obtaining the wax pattern, it is most undesirable from a retention standpoint, because the efficiency of the cement is dependent on a slightly roughened surface. Consequently, all abutments should be ground or roughened slightly within 1 mm. of the margins, as well as the cavity walls, in order to secure maximum retention from the cement media.

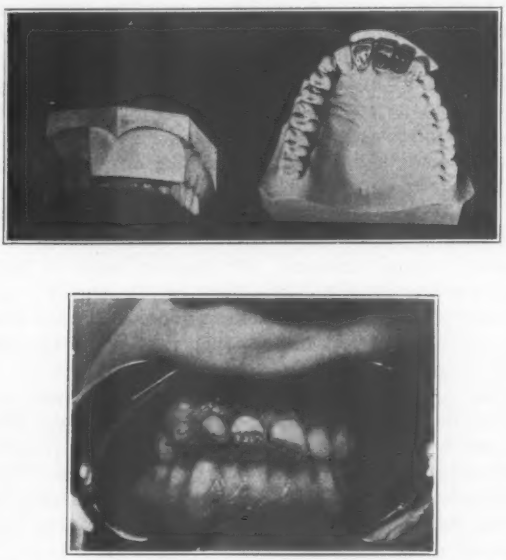

Fig. 5.—Above: Second plaster matrix, used to hold facings with baked saddles in place on working cast in carving wax patterns, and for holding pontics in correct position after backings have been cast in waxing joints prior to soldering. Below: Case waxed in mouth with one soldered joint unsoldered, prior to taking lingual impression. The wire reinforcement is held in place with sticky wax.

### OCCLUSION

Few bridge abutments and pontics have the occlusal form of the teeth which they replace. In many instances, they are flat and featureless, no attempt having been made to reproduce anatomic detail. Mere indentations do provide for opposing cusps in centric occlusion, but they do not provide paths for lateral excursion. Without these paths, there is cuspal interference and trauma to the abutment teeth, as well as to the opposing teeth. On the other hand, many abutments and pontics are never in functional occlusion in the lateral ranges because the sulcus angle of the occlusal surfaces is not identical with that of the natural teeth. A close examination of the occlusal surfaces of bridges that are failures discloses that many of them bear the telltale sign, bright, condensed spots on the dulled surface of the gold—mute evidence of traumatic occlusion.

The occlusal area of the pontics gov-

erns to a great extent the relative load delivered to the abutments. Double the diameter of a pontic and you increase its occlusal area four times. Yet we frequently see occlusal surfaces much wider than those of the natural teeth which they replace. Occlusal embrasures, in many instances, are entirely lacking or filled with solder, which eliminates all of the embrasure and increases the occlusal area considerably.

Spillways, which open the mesial or distal marginal ridges, permitting the food to escape over the ridges into the lingual embrasures, are seldom seen or reproduced on the occlusal surfaces of bridges. They should never be omitted, for their function is definite in decreasing the occlusal stress or load, in addition to giving and maintaining the physiologic tone to the septal and underlying tissues resulting from massage during the process of mastication.

### ESTHETIC UNITY

"Artistic creation," says Aristotle, "springs from the formative impulse and the craving for emotional expression. Essentially, the form of art is an imitation of reality; it holds the mirror up to Nature. The noblest art appeals to the intellect as well as to the feelings (as a symphony appeals to us not only by its harmonies and sequences, but also by its structure and development); and this intellectual pleasure is the highest form of joy to which man can rise. Hence, a work of art should aim at form, and above all at unity, which is the backbone of structure and the focus of form."

The esthetic standards of the fixed bridge pontic are primarily determined by the artistic quality of the porcelain used, and an anatomic basis demands that the porcelain be so shaped that an anatomic relationship and color harmony are possible with the existing environment.

Failure to employ correct tooth form has, in many instances, resulted in an unnatural appearance. Classifications of tooth forms have been carefully made by Williams, House and others, but, at present, facings of only the average typal forms are available. Consequently, a facing approximate in form is selected and is ground or altered so that it conforms in shape and contour to the tooth being replaced.

Extensive study and research have been conducted to determine color range, and much credit is due for this comprehensive work. Clark found that "a total of 532 different colors were necessary and sufficient in minimum number for the complete specifications of tooth color." The "Master Guide" of one manufacturer contained 2,513 shades, which were later reduced to 170 and finally to twenty-four shades. This accounts for many mismatches and the impossibility of matching natural teeth with stock facings.

The surface luster can easily be made to conform to that of the natural teeth. If greater luster is desired, a surface glaze can be applied and fused; if less, the surface luster can be reduced with a paper disk or rubber wheel containing pumice.

The present trend is toward more translucent porcelain, but, at present, its possibilities and application are far from being fully realized. While translucency can be measured photometrically, it is unfortunate that very few data are available on translucency and its variability in different teeth. Furthermore, the gold alloy backing and the opaque cement add to the complexity of the problem.

While manufacturers have recently made a great effort to produce better teeth, with much improvement in color and form, there is also some renewed interest in producing facings more natural in form and surface markings, and more nearly simulating the shades and translucency of the natural teeth. It is hoped that this greatly needed improve-

ment in facings for bridge restorations will soon be met.

Esthetically, the upper anterior teeth are the most important, and great care must be exercised in their replacement. The two central incisor teeth especially, because, owing to their position, their labial surfaces are very prominent, must conform both in form and shade with the patient's individual characteristics. Nothing is more distracting in the restorative field than the use of an incorrectly alined pontic, of the wrong form and off color or shade. In fact, these three factors are of such importance that an error, especially in form and the relationship of the lips and anterior teeth, may change the patient's entire visual personality.

So much information is now available on the staining of porcelain that I shall not discuss the methods or technics involved. Needless to say, the modifying and staining of porcelain facings, when artistically done, will add much to the esthetic values of the fixed bridge restoration.

Pink porcelain may at times be used to extend porcelain tips or saddles, to avoid the appearance of gum recession, etc. Unfortunately, it is not possible to match tissue exactly with any pink or so-called pink gum porcelain or stain now available. Its general color, however, may be modified by the use of yellow, blue, white, etc., so that it blends with the existing environment and, in the shadow of the cheek and lips, minimizes the prominence of such extensions or additions.

### IMMEDIATE REPLACEMENT FOLLOWING EXTRACTION

The extraction or loss by accident of one or more anterior teeth generally involves the perplexing problem of immediate replacement. Because of their esthetic value and the possibility of affecting speech, causing distortion of the facial expression and, at times, implanting a feeling of inferiority, the solution of this problem is of vital importance.

As a rule, most patients are reluctant to go without teeth, especially in the anterior region, until the ridge is sufficiently healed. The problem of supplying such teeth immediately after extraction resolves itself into some method for temporary replacement until the ridge is in condition for a permanent restoration.

We have found that if a partial denture or removable appliance is made prior to extraction of the teeth and placed immediately after extraction, the esthetic requirements are met, the abutment teeth are kept from shifting and aid is given in shaping or molding the ridge tissues, provided care is exercised in construction. Furthermore, the psychologic effect upon the patient of changing from the temporary partial to a fixed bridge restoration is most gratifying. After using this method in varying forms for more than fifteen years, I feel that this is the best method of immediate replacement in practically all cases.

The temporary partial dentures are easily made and the cost of materials is slight. All that is needed is a small amount of vulcanite rubber or newer base material, a tooth or teeth and a piece of stainless steel wire for the clasps or embrasure hooks. The denture is constructed on an artificial stone cast made from an impression obtained before the teeth are extracted. The artificial stone teeth corresponding to those to be extracted are cut away and the ridge shaped to as nearly as possible approximate the healed ridge.

If all the posterior teeth are present, two embrasure clasps of about 0.025 gage stainless steel wire are made, being so designed that they cross the occlusal embrasure and terminate in an arm extending over the buccal surface of the upper second bicuspid or first molar. The other end of the wire will end lingually in a loop or continue across to the other side, terminating in a similar clasp. The pur-

pose of the loop or extension is to provide anchorage in the base material. The case is then waxed with the teeth and wire in position, the wax being so shaped that the completed vault portion will be of horseshoe shape. It is then flasked and vulcanized, or cured, if one of the newer base materials is used, in the usual manner. I have suggested only one type of clasp or retainer, but these stainless steel wire retainers can easily be shaped or adapted to meet the requirements of any case.

When the partial denture is completed, the tooth or teeth are extracted and the partial denture is placed immediately thereafter and while the anesthesia is still active. As in all partial dentures, some slight adjustment or fitting will have to be made at this time.

Various other methods have been suggested and tried, but all are more or less unsatisfactory because it is impossible to predetermine the extent of recession rootwise in the proximogingival areas of the abutment teeth, the extent of resorption or the loss of tissue at the time of extraction.

When the patient objects to wearing a partial denture, another alternative is to construct the bridge, prior to extraction, approximating as nearly as possible the amount of recession or resorption. Such fixed bridges should be set temporarily. After the ridge is completely healed, the bridge is removed, and such alterations of the tips or saddles are made as are necessary. At times, the entire bridge will have to be reconstructed to conform to the recession and other changed conditions.

### PONTICS

The long pin facing pontic, with a porcelain tip in the posterior and saddle in the anterior region of the mouth, is given preference wherever vertical length will permit its use. At times, it may be necessary to resort to surgical treatment to provide satisfactory ridge and space conditions. Its gingival area of high-fusing, highly glazed porcelain can be shaped to conform to the healed ridge, to meet the requirements of hygiene and provide intermittent pressure and massage to the underlying tissue. The use of oversized, angular, poorly shaped tips or saddles that cause undue pressure against the ridge tissues is not in accord with biologic or hygienic demands, eventually causing pressure atrophy, hypertrophy or inflammation of the tissues involved.

Unfortunately, we do not have a porcelain tipped pontic with a porcelain occlusal surface that is equal in strength to the gold-porcelain combination. Hygienically, with the possible exception of the reenforced baked porcelain pontic, all porcelain occlusal pontics necessitate encroaching upon or closing the interproximal space resulting from the gingival location of the solder joint.

### PLASTER MATRICES

In order to retain the desired alinement and relationship of the facings and the tips to the ridge, from the time the facings are ground and waxed to position and until the bridge units are united, it is necessary to develop two plaster matrices. The first includes the incisal and labial, or the occlusal and buccal surfaces. For both anterior and posterior restorations, the gingival third of the facings and the ridge area to which the tips or saddles are to be attached are left exposed. Such a matrix maintains the relationship and aids in the accurate adaptation of the baked porcelain to the ridge on the working cast. After the tips or saddles have been glazed, they are placed in the matrix on the working cast and held securely with sticky wax placed on the lingual surface.

The plaster matrix is then removed and a labial or buccal matrix poured; which leaves the incisal or buccal one-fourth of the facing exposed. The wax on the lingual surface is then removed and sufficient softened inlay wax forced

to place for carving the wax pattern. This second plaster matrix holds the porcelain portion of the pontic in correct relationship and facilitates carving of the wax pattern to anatomic form and functional occlusion.

When the backings have been cast and fitted, the completed pontic is placed in the plaster matrix and waxed to position as originally planned.

### GRINDING

After the porcelain tip or saddle has been baked to a high glaze, it will be found that the backing base is slightly distorted and the edges of the tip and facing are slightly rounded. In order to secure an accurately fitting wax pattern and gold backing, the backing base must be ground flat with a carborundum disk and a definite bevel or margin established around the periphery of the backing base and along the angles of the facing, which becomes rounded during the fusing of the porcelain tip. A long rather than a short incisal or occlusal bevel is ground for protection against breakage, this providing for a sufficient thickness of hard gold alloy. It is needless to say that a careful adjustment of the occlusion will also materially lessen the possibilities of breakage, which might result from trauma.

### WAXING AND SWAGING

The wax pattern area of the porcelain is lubricated and placed in position in the plaster matrix on the working cast. Soft inlay wax is pressed to place and the opposing teeth are pressed into the soft wax. The occlusal surface is then carved. The waxed pontic is then removed from the plaster matrix and working cast and the other surfaces of the wax are fully contoured and carved to definite margins. The wax pattern on the porcelain-tipped facing is then placed in a water swager filled with water at 112° F. When the wax has attained this temperature throughout, the swager is closed. One blow from a 4-pound hammer swages the wax against the porcelain, an accurate fit of the wax to the porcelain resulting. On removal from the swager, the rubber dam, in which it was enclosed prior to being placed in the swager, is taken off and the wax pattern is allowed to cool to room temperature. The sprue is then placed and the wax pattern is removed from the porcelain.

### PINHOLES IN BACKINGS

Failure to have the pinholes accurately positioned or alined in the cast backing results in misfits of the porcelain to the gold. The carbon rod technic commonly used is not entirely satisfactory, for it is difficult to accurately place them in the wax pattern. Furthermore, elimination of the gas from the carbon during the casting process quite frequently causes hollow or defective castings. The use of round metal tubes, placed on the pins and incorporated in the wax pattern, is the most satisfactory procedure. These tubes are held in place with stainless steel round wire of suitable size, during the casting process. When the holes extend through the wax pattern, the tube and wire may be dispensed with, the holes being filled with investment material during investment of the wax pattern. For bicuspid and molar pontics, holes may be drilled in the wax pattern from the backing base connecting at right angles with the pinholes. The chief objection to this procedure is the possibility of entrapping air or not getting investment material of sufficient density into the holes. When this does occur, the investment rods do not have sufficient strength and so break down during the casting process, a defective pinhole, or complete loss of the pinhole, resulting.

### PORCELAIN OCCLUSAL SURFACE PONTICS

The use of porcelain occlusal surface pontics affords more esthetic results. They can be used to advantage where

opposed by porcelain teeth on a denture. Unfortunately, this type requires considerable gingivoclusal length, to provide for bulk of porcelain, for adequate gold support, and correct shaping of the gingival area.

### TUBE TOOTH PONTICS

Molds of posterior tube teeth are now available with occlusal surfaces without the central hole. This type of pontic provides the desirable porcelain occlusal surface and porcelain tip, but is objectionable owing to the showing of gold on the buccal surface, and is therefore limited to those cases in which the middle or gingival third of the buccal surface is obscured by the cheek or lips.

The porcelain tooth is ground so that a collar or cradle encircling the entire tooth can be constructed for the support and attachment of the pontic to the abutments. Soldering areas must be provided by grinding deep grooves in the mesial and distal surfaces, to assure ample bulk of gold in these areas.

Where the cone-shaped tip is used, the collar must be in the middle third; but, for the saddle type, the buccal portion can usually be made in the gingival third. To obtain maximum strength, it is necessary that the gold collar completely encircle the porcelain. In an attempt to eliminate gold on the buccal surface, this type of pontic is sometimes constructed so that the collar is not completed, but terminates at the proximobuccal line angle. This construction weakens the pontic considerably and greatly increases the possibilities of fracture when stress is exerted on the buccal cusps.

### DIATORIC TOOTH PONTIC

Diatoric posterior denture teeth available in anatomic cusp forms, as well as modified forms, such as 20 degree lateral inclination and cuspless, provide a wide range from which to make a selection. By baking porcelain on the gingival portion to the desired shape, a pontic similar to the tube tooth can be made.

In the past, the diatoric tooth has been used in conjunction with the cast gold alloy gingival portion for contour and support. Such construction is generally undesirable because it places gold instead of glazed porcelain in the gingival area, and the solder joint is placed so far gingivally that the interproximal spaces are generally filled with solder.

### BAKED PORCELAIN PONTICS

Baked porcelain pontics are generally used in conjunction with reenforced porcelain. Either the entire pontic is constructed of porcelain baked directly to the reenforcing porcelain or a diatoric tooth is used for the occlusal area, which is attached to the reenforcing porcelain and contoured to the shape desired, with baked porcelain. Similarly, anterior facings or interchangeable pontics can be used for anterior construction.

The reenforced all-porcelain pontic eliminates entirely the display of gold and, from an esthetic and hygienic standpoint, is most desirable. While this pontic affords a reasonable degree of strength, its use is limited to cases wherein occlusal stresses are favorable, as, otherwise, breakage or fracture will result.

### UNITING PONTICS TO ABUTMENTS

Assuming that every precaution has been taken to have the abutments parallel and in correct alinement with each other, there are still possibilities of error which will prevent the completed bridge from going to place or being seated without undue strain. Poor impressions, failure to seat the abutments correctly in the impression, shifting of the abutment teeth, displacing abutments in pouring soldering investment into the impression and distortion occurring during the uniting of the abutments to the pontics are errors that might occur during

the construction or uniting of the fixed bridge units.

Many leaky and defective abutment margins that were perfect when the abutments were seated separately have, owing to shrinkage or distortion during the soldering process, lost their relationship to each other and the abutment teeth, open margins or strained conditions which eventually cause the abutments to loosen resulting.

### SECTIONAL OR UNIT SOLDERING

By soldering the bridge in sections or units, with metal contacts between the abutments and pontics, so that the minimum amount of solder will be required, such errors can be eliminated. Take, for example, an upper anterior bridge with four pontics and two three-quarter crown abutments: Because of the long span and curvature, the possibilities for distortion are great. By casting the pontics separately and waxing them together, and securing a plaster impression of the lingual surfaces with the plaster matrix in place on the labial surfaces, the pontics can be removed and soldered together in one unit; or the wax patterns for the four pontics can be carved and cast *en bloc.*

After the pontics are soldered into one unit, they are waxed in position on the soldering investment working cast with fluxed wax held firmly with sticky wax, invested and soldered to one three-quarter crown only, the other three-quarter crown not being soldered to the pontics at this time. The three-quarter crown and the solder section of the bridge are placed in the mouth and checked for fit, alinement, porcelain and ridge contact, etc. The three-quarter crown and pontics are then waxed together with hard sticky wax, with a piece of wire for reenforcement on the labial surface of the pontics, the cuspid tooth over the unsoldered joint holding it sufficiently rigid that a plaster impression of the lingual surface of the bridge can be taken without losing relationship. With the plaster impression taken, the bridge units are removed and then carefully seated in the plaster impression. The facings having been previously removed, the entire labial area of the bridge is invested with soldering investment. When it has set, the plaster impression is removed from the lingual aspect, the case heated and the final joint soldered.

At no time should two abutments be united to a pontic or pontics on the soldering investment cast. The final joint between the other abutment and pontic should be soldered only after the case has been tried in the mouth, and a relationship impression, in plaster, of the lingual surface of the anterior, and a shallow impression of the posterior cases, have been obtained.

### ELIMINATING STRESS FROM THE SOLDER JOINT

If it is deemed desirable, stress can be eliminated from the solder joint on posterior bridges by providing seats in the abutments so that extensions of gold alloy cast with the pontic will rest in these seats instead of being suspended by solder joints.

When sufficient bulk is available on the axial surfaces of the abutments adjacent to the edentulous space, vertical slots are cut parallel with each other, terminating in a seat in the middle or gingival third of the abutments. Or if sufficient bulk is not available for the vertical slot, an occlusal seat similar to one prepared for the rest lug of a clasp is made on the occlusal surface of both abutments. Extensions or lugs are developed in the wax patterns of the pontics fitting into the slots or occlusal rest seats, and cast on the pontics. Upon completion, the pontic is then soldered to the one abutment and tried in the mouth, and the relationship impression is taken, removed and soldered, according to the technic previously outlined.

ELIMINATION OF THE SOLDER JOINTS

Casting the entire bridge at one time has been suggested as a means whereby soldering errors might be eliminated. While it would eliminate such possible errors, the one-piece casting introduces variables and possible errors common to the casting technics. In addition, the same degree of expansion is obtained for all types of abutments used, and the entire bridge must be cast of the same gold alloy.

Another method whereby the abutments can be made by the direct method consists in making inverted cone slots in the proximal surfaces adjacent to the pontics. An impression is taken with the slotted abutments in place, and a working cast of inlay investment is secured. The backings for the pontics are carved in wax with extensions into the undercuts or inverted cone slots in the abutments. The cast is then trimmed to minimum size so that it can be invested and the pontics are cast. By this method, the pontics are cast and united directly to the abutments without the aid of solder.

# THE RÔLE OF DIET IN THE CONTROL OF DENTINAL CARIES*

By JULIAN D. BOYD, M.D., Iowa City, Iowa

SINCE 1926, joint medical and dental studies of children have been conducted at the Children's Hospital of the State University of Iowa. Dr. Drain first noted that exposed dentin, typically softened in areas of caries, became stony hard in certain children during their period of observation at the hospital. Investigation revealed that each of the children showing this phenomenon was under strict dietary control for one purpose or another. Further studies indicated that extension or initiation of tooth decay could be prevented and active decay arrested through the continued ingestion of suitable diets.

This report is based on a statistical study of the records of certain children observed during the interval between the year 1926 and the time of Dr. Drain's death in 1937. The subjects, about 250, included only children who had been observed repeatedly at the Children's Hospital over periods of months or years. This was the sole criterion used in sampling.

About 80 per cent of the total included were living under quantitatively prescribed dietary regimens. The remainder, who were not under any form of diet control, were under prolonged recurrent hospital supervision for the treatment of latent hereditary syphilis.

Of the subjects under dietary control, a minority were children without disease, who were chosen from an orphanage to serve as long-time subjects for

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*Work done in collaboration with Charles L. Drain, D.D.S., who at the time of his death was a teacher in the Department of Pedodontia, University of Iowa, College of Dentistry.

metabolic balance studies. All presented active dental caries at the beginning of the studies. The remainder of the children considered in this report were under management for diabetes mellitus.

In the group at large, the apparent health of the subjects was normal or excellent. In each, the abnormality of metabolism or the disease was ostensibly under control through suitable therapeutic procedures, and laboratory tests would be necessary in every instance to establish the existence of active disease. The study deals with the presence, extent and degree of activity of tooth decay in these children when first observed and at subsequent times. The observed changes in dental status are amenable to analysis in terms of local oral conditions, general level of health, nature of the diet and other relevant facts.

In summary, it was found that children under dietary control showed a preponderant tendency to develop sclerosis of exposed dentin in carious areas within a few weeks or months after the dietary regimen was established, and to show no further progress of decay as long as that regimen was followed in its entirety. A similar state was not found in the children who were not receiving controlled diets. When the oral conditions in the children of the two groups were contrasted after equivalent periods of observation, it was found that residual caries tended definitely to retrogress in those under dietary control and to progress in the other children. Parallel comparisons are available over periods of from four to six years, and the difference between the two groups is of such constancy and magnitude that the possibility of its being a chance occurrence is slight.

The group of diabetic subjects included 175 children, ranging in age from 2 to 20 years. The average at the first and at the terminal observation was $9\frac{1}{2}$ and $13\frac{3}{4}$ years, respectively. One hundred and twenty-seven of these children were observed for a minimum period of two years, fifty-three for five years or longer, eighteen for more than eight years and eight for more than ten years. The average number of joint dental and medical observations was twelve per child, and forty-six months was the average duration of intermittent observation.

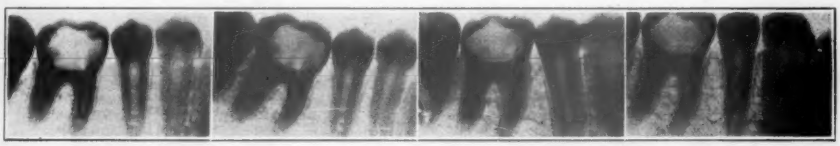

Fig. 1.—Successive roentgenograms of a carious tooth, made on March 15, 1934, November 19, 1934, June 10, 1935, and April 11, 1936 respectively. Nothing whatever was done to the tooth. The nature of the cavity was such that it was not self-cleansing. At the first observation the exposed dentin was slightly penetrable with the exploring tine. At that time the prescription of a complete diet had recently been made and its administration supervised. Its use was maintained throughout the whole period of observation. Subsequent examinations all revealed a stony impenetrable dentin.

Thirty of these children had teeth free from caries or fillings at the time of the first observation and remained of that status throughout the whole course of observation. The remainder either had some degree of caries when first seen or soon developed it.

Of these 145 children, 128 developed firm sclerosis of exposed dentin within a period of from three to six months, with corresponding arrest of decay. An additional thirteen developed noteworthy sclerosis, but not so complete as was noted in the majority. This state comprises essential arrest, but the caries must

be considered latent. Four children, who failed to cooperate in the prescribed regimen in its entirety, did not develop noteworthy dentinal sclerosis. Of the 128 who developed arrest of decay, forty-six maintained that state throughout the subsequent period of observation. In the remaining eighty-two, an average period of forty-four months and eighteen days elapsed before further activity was noted. Four of these children again reached a state of maintained arrest and seventy-one developed stages of minimal activity and remained in that state, while only seven had noteworthy activity. The last named included children who were notorious in their failure to follow the prescribed regimen.

Cooperation in the management of

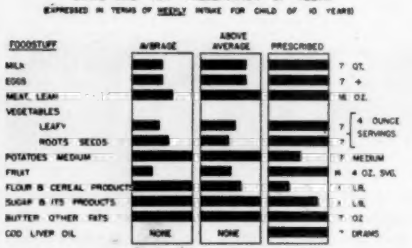


Figure 2.

diabetes mellitus is customary during the early months of treatment. Once the parents have passed the initial emotional crisis resulting from recognition of the disease in the child, there is a tendency for parents and patient to exercise less care so far as this laxness does not seem to be reflected in the immediate well-being of the child. This leads to parental modification of the prescribed dietary regimen. Clinically, one of the most dependable evidences of lax management has been the reactivation of caries. Once this is brought to the attention of the parents, and they are convinced of the need for greater care than may have seemed necessary to them, the prescribed regimen is readopted more or less riggorously.

Twenty-one non-diabetic children, free from any apparent disease, were objects of metabolic study for periods averaging five months. Each of these children had active caries when first observed. In fact, the children were chosen for study because of this fact. The average period of observation of these children was five months, during which all food eaten was prescribed and weighed and its ingestion supervised. During observation, complete sclerosis of exposed dentin became demonstrable in fourteen mouths, and essential arrest was observed in four more. The three children who did not show arrest were designedly under dietary regimens which were incomplete for optimal nutrition; two receiving an inade-

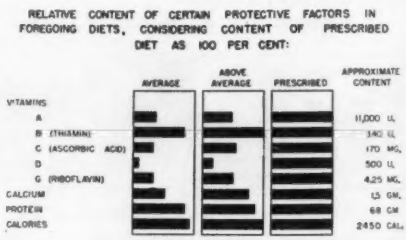


Figure 3.

quate amount of vitamin A and the third a diet low in milk and containing no cod-liver oil.

Most students of dental caries have used the appearance of new areas of decay as a basis for their observations, rather than the consistency of the exposed dentin. We have believed that the firmness of exposed dentin offers a more certain criterion, and that, through this agency, a shorter interval is necessary to establish change in the dental status.

To make such observations possible, it has been the custom to leave some or all of the dental cavities unfilled until sclerosis is well established, or even for the life of some deciduous teeth. In spite of this lack of reparative treatment,

such teeth have not developed further evidence of decay, even though their contour was such that cleansing or scouring was impossible. Figure 1 exemplifies this fact.

In order to make our data comparable with those of others, the accompanying table includes the average progress in numbers of cavities of subjects under prolonged observation, permitting contrast between those receiving controlled and those on free-choice diets. In order to make such comparisons valid, the factor of shedding must be taken into consideration. For this reason, each group has been subdivided into the period prior to the loss of any deciduous teeth, that of shedding and that following the completion of exfoliation.

The averages for each group are presented in the accompanying table together with the standard deviation and standard error. The number of non-controlled children in the youngest group was insufficient for statistical purposes. The column at the extreme right indicates the critical ratio between corresponding values for the children with and for those without dietary control. Wherever this value equals or exceeds 3, it offers evidence that the difference between the two values is of statistical significance, and the probability that these differences are attributable to chance is very remote, the odds against this being due to random sampling being 148:1.

These data seem to establish beyond controversy that caries can be controlled through the adoption of a regimen which appears to have no direct relationship to the status of the mouth. The cause for difference in the response of the two groups of children herein compared may be approached through a study of the factors in the regimen followed by each group.

Certain factors may be excluded readily, since the subject personnel as a whole had a similar ethnic, geographic and socio-economic status. Practically without exception, the children came from families of indigent or of borderline economic status. So far as the diet was concerned, arrangements were made in local communities to help provide the prescribed foods for the group under diet control. The other children did not receive such consideration.

At the initial observation of each child, the physique and general level of health tended to be that of the average child from such a socio-economic group. This status did not change in the children who did not receive dietary guidance. In the children with diabetes mellitus, the advance in apparent health and vigor was outstanding, placing them as a group in a superior status.

Oral hygiene tended to be decidedly poor in each group, not only at the start, but throughout all observations. There was no apparent correlation between the degree of cleanliness of the teeth and gingivae and the tendency for caries to progress or to retrogress. Medication received by the patients apparently was not a factor in the progress or retardation of caries. This is evidenced in the children with syphilis by the fact that the rate of progress of decay was about that to be predicted in any uncontrolled group of children in this area. In those under diet control, caries was arrested as readily in the non-diabetic as in the diabetic group, when equally stringent control of food intake was practiced.

In evaluating the part played by diet, one should have in mind the various ways in which it might affect the teeth either favorably or adversely. Some workers have attributed decay to the lack of detergent qualities in the foods eaten, whereas others have felt that caries is caused by the chewing of hard foods, which causes enamel fracture and impaction of fermentable material. Emphasis has been placed by some workers on the deleterious effect of starch residues or of sugars remaining in the mouth and furthering acid production.

PROGRESSIVE INCIDENCE OF CARIES IN TWO LARGE GROUPS OF CHILDREN, SUBDIVIDED AS TO STATE OF EXFOLIATION: TO COMPARE EFFECT OF CONTROLLED AND OF UNCONTROLLED DIET

| | Group A Under Dietary Management | | | | Group B No Dietary Control | | | | Critical Ratio |
|---|---|---|---|---|---|---|---|---|---|
| | Number of Subjects | Av. No. Cavities | S.D.* | S.E.* | Number of Subjects | Av. No. Cavities | S.D.* | S.E.* | |
| **I. Children Observed Prior to Shedding of Any Deciduous Teeth** | | | | | | | | | |
| 1st observation | 18 (Av. age 29 mo.) | 1.5 | 1.3 | 0.31 | Insufficient number for correlation | | | | |
| 2 years later | 18 | 2.4 | 2.5 | 0.58 | | | | | |
| 4 years later | 11 | 2.5 | 2.8 | 0.84 | | | | | |
| **II. Children Observed During Period of Shedding of Deciduous Teeth** | | | | | | | | | |
| 1st observation | 65 (Av. age 89 mo.) | 6.87 | 4.4 | 0.54 | 38 (Av. age 94 mo.) | 7.5 | 4.1 | 0.67 | 0.7 |
| 2 years later | 65 | 5.38 | 4.1 | 0.50 | 38 | 7.4 | 3.5 | 0.56 | 2.8 |
| 4 years later | 50 | 4.4 | 3.3 | 0.47 | 25 | 7.7 | 2.9 | 0.58 | 4.3 |
| 6 years later | 41 | 4.2 | 4.2 | 0.65 | 11 | 7.8 | 3.4 | 1.00 | 3.0 |
| 8 years later | 28 | 4.5 | 5.0 | 0.95 | Insufficient number | | | | |
| **III. Children Observed After Shedding of Deciduous Teeth** | | | | | | | | | |
| 1st observation | 62 (Av. age 156 mo.) | 5.0 | 3.3 | 0.41 | 19 (Av. age 161 mo.) | 6.9 | 2.5 | 0.57 | 2.7 |
| 2 years later | 62 | 5.6 | 3.7 | 0.47 | 19 | 8.4 | 3.3 | 0.76 | 3.1 |
| 4 years later | 39 | 6.2 | 3.5 | 0.56 | 7 | 10.2 | 1.7 | 0.66 | 4.6 |
| 6 years later | 11 | 5.4 | 4.2 | 1.30 | No data | | | | |

*S.D. represents the standard deviation; S.E., the standard error. The critical ratio indicates the possibility that the observed differences may be explained through chance. Values of three or more preclude chance relationship, and values approximating three tend to establish that the comparison is valid. The data indicate distinct lessening in the incidence of caries in the groups under controlled diets. This becomes statistically apparent at two years of observation, and is well established at subsequent observations.

In contrast to those who consider food as primarily a local factor in decay, other workers have expressed the belief that metabolic changes may be induced in some manner by the nature of the diet, and thus affect the susceptibility of the tooth to decay. From this point of view, the nature of the diet may be considered as to certain of its factors, the acid-base relationships of the dietary ash or the completeness of the diet as a whole.

Information concerning the rôle played by some of these factors can be drawn from our studies. The consistency of foods has seemed to play no outstanding part, since, in some of the children showing arrest of caries,[1] the diets were restricted for periods of months to foods requiring no chewing, yet these diets seemed as effective in controlling caries as those which included foods requiring thorough mastication. None of the prescribed diets employed in this study included foods the chewing of which might lead to impaction fracture of enamel.

Diets which have led to arrest of caries have varied widely in the carbohydrate component, as to both amount and nature. Some children developed arrest of caries while receiving more than 60 per cent of their calories in the form of dextrose, for periods of months.[1] The diabetic children who served as subjects of our first reports received diets preponderantly low in carbohydrate and correspondingly high in fat, which supplied three-fourths of the calories of those diets.

During the past five years, however, equivalent arrest of caries has been observed in diabetic children who received diets of a carbohydrate content similar to that supplied by the diets recommended for the normal child. About half the calories in the diabetic diets prescribed during that interval have been supplied as carbohydrate. From this, it may be said definitely that high fat diets are not requisite for the control of caries and that considerable amounts of carbohydrate in the diet are compatible with such control. Whereas liberal use is made of the low-carbohydrate vegetables and fruits, foods such as bread, potato and cereal are included in each meal.

It is important to recognize that the amount of carbohydrate eaten daily by the average child is considerably in excess of that which we prescribe for normal child nutrition. Still more important, it is believed, is the fact that prevalent diets restrict the carbohydrate foods largely to refined cereals, starches and sugars, to the relative exclusion of carbohydrate foods which contribute protective factors as well as energy.

The most consistent characteristic of the varied diets which we have found favorable for tooth preservation has been the high content of these so-called protective factors—dietary elements which are essential both qualitatively and quantitatively for normal growth and functioning of the body and its component tissues. These diets have been based on liberal allowances of milk, eggs, vegetables and fruits and they include cod-liver oil.

Whereas each type of diet which we have employed will yield a neutral or a basic ash, we do not believe that this characteristic is responsible for the preservation of the teeth. It is the belief that the explanation lies in the furtherance of complete and optimum nutrition, thereby offering the teeth full opportunity to resist destructive agencies. The diets which have been used furnish larger amounts of most protective factors than are commonly ingested, in some instances exceeding the amounts frequently stated as necessary for normal nutrition. The observations lead us to believe that in certain individuals, the requirements ex-

1. Patients with celiac disease, not included in tabulations because of small number in series.

ceed the amount which may seem adequate for others. The general physical response, as well as the dental status, has encouraged us to recommend these higher standards of intake. (See Figs. 2 and 3.)

The improvement of the ordinary diet is attained through increase in amounts of milk and its products, eggs, vegetables and fruits and cod-liver oil. With the exception of the use of cod-liver oil as a supplement to the intake of vitamins A and D, desirable levels of intake of protective factors have been attained through the use of readily available foodstuffs. The use of the various proprietary vitamin and mineral products as substitutes for natural food sources of essential factors is not advocated. Unless such substitutions are made by persons skilled in the science of nutrition, substitution usually is incomplete, and may result in concealing a deficiency of factors which have not been taken into consideration.

The age of the patient seems to play an important part in the development or extension of caries. In each of the groups of children included in this study, the tendency toward progression of caries was increased during the teen ages. Although of less degree, this was noted in those under dietary prescription as well as those who chose their own diets without guidance. We have no assurance that those subjects in whom there was an extension of caries during the period of active growth were faithful in their diets. In fact, it has been difficult to maintain during that period of life the cooperation of our patients that was given prior or subsequently to that time.

It is known that the strains on metabolic processes are increased at periods of rapid growth, and that the endocrine balance is undergoing readjustment at such times. Any or all of these variables may be involved in the condition of the teeth of these children. On the other hand, it is not easy to explain the increased tendency to caries which children of this age group show on the basis of local oral conditions, such as mouth hygiene or a change in the predominant oral flora.

Irrefutable evidence is not yet at hand to establish fully the etiology and pathogenesis of caries. Possibly new avenues of attack on the problem will be necessary to obtain the final answer. From our data, it seems necessary to recognize the importance of metabolic factors in any explanation of dental disease. Of such factors, the most important is the completeness of the diet in the various essentials for normal tissue building and functioning. Whereas we might be led to speculate as to the relative importance of one nutritional component for dental health as compared with certain others, this seems unwise. Good results have been obtained when attention was directed toward the optimum nutrition of the child as a whole, rather than toward the status of his teeth.

Each of us who is working in the field of health or of disease should be more interested in the individual than in any part of him. To place special emphasis on any single nutritional essential in the prevention of caries would lead to lessened consideration of other components which may be equally or even more essential for general health and well-being.

The child with active caries must be considered to have a disturbance of metabolism, and this can be corrected most effectively through enrichment of the diet so that it will favor an optimum state of nutrition. Such treatment is conservative. It cannot lead to harm if carried out with insight, and it conserves not only the teeth, but also their possessor.

# A CONSIDERATION OF THE SURGICAL TREATMENT OF PERIODONTAL LESIONS

By RAOUL H. BLANQUIE, D.D.S., F.A.C.D., San Francisco, Calif.

THE several different methods of treating periodontal lesions by surgical intervention require varying degrees of tissue removal. These procedures vary from the cutting away of but a portion of the loose, detached tissue forming the outer wall of the lesion to the complete stripping of all soft tissue occlusally of the level of the alveolar border. The latter procedure, which, in the main, is the subject of this paper, involves the complete eradication of all disorganized and diseased soft tissue forming and underlying the pocket, and brings the line of incision entirely within healthy, normal structures. This therapy does not require as routine practice the removal of any portion of the alveolar process, unless warranted by certain conditions which occur but occasionally.

Any *modus operandi* that involves the obliteration of the periodontal pocket in its entirety, including the removal of all degenerative connective tissue extending into the alveolar process, may be deemed satisfactory from the standpoint of objective. The degree of accuracy and accessibility attending the operation is largely dependent on the type of instruments employed. It is practical, however, so far as operative expediency is concerned, to follow a technic embracing definite steps and employing instruments of a design permitting ready access to the affected parts. The technic which seems to present the most advantages and the simplicity of which enables it to be imparted successfully to dental students was developed by A. W. Ward, in 1920. This work may be considered the refinement of procedures that were advocated by Bourdet in the eighteenth century and Black in contemporary times.

Prior to operating, it is advisable to medicate the periodontal pockets with a 5 per cent solution of mercurochrome. This precautionary measure, which may be repeated at two sittings, will be found conducive to better postoperative results. Besides reducing bacterial activity within the lesions, it permits operating in a much cleaner field. The medicament can be conveniently applied with the aid of a rubber cup mounted on a suitable handle, by which it is pumped subgingivally. This procedure was first suggested by Vastine.

In the operative technic, the septal gingiva is first removed and the space that it occupied is left devoid of all soft tissue, with exposure of the alveolar ridge. This extirpation is carried out with the "interproximal curet," used as a saw through this tissue, which is ordinarily firm and quite resistant to the usual cutting measures. Two incisions are made in the embrasure, one mesially and the other distally, and carried through until the surface of bone is reached. These cuts are joined by an incision made at their base, by turning the instrument a quarter turn and thus freeing the entire septal gingiva, which may then be forced out in a single section. A large sickle type scaler can be used to advantage, espe-

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cially in the molar region, to further insure the removal of all connective tissue adherent to the alveolar process.

The interproximal dissections are used as landmarks in the removal of the labial (or buccal) and lingual flaps that are left standing. These crevices are joined by means of suitably shaped knives, the facial and lingual walls of the pocket being thereby removed and, at the same time, the border of the alveolar cortical plates uncovered.

At this point of the operation, all soft tissue occlusally of the level of the alveolar process has been removed. The cortical plates on both sides of the ridge are then smoothed of all spicules with a bone hoe, and all overhanging soft tissue is excised with surgical shears.

A great deal of misinformation seems to prevail regarding the use of the "interproximal curet." The belief that bone is sacrificed by the employment of this instrument is without foundation. It is shaped with serrations which cut the dense detached interproximal tissue cleanly and accurately. Its only effect upon bone is to smooth down any sharp projections that would otherwise cause irritation. To remove bone, it is necessary to use a surgical chisel, which is justified under certain conditions. Often, the height of the alveolar septa differs between adjacent teeth. If left in this condition, pockets will be reestablished over the crests having the greatest resorption to the level of the adjoining higher septum, as the gingivae tend to seek an even horizontal plane. In order to obviate this undesirable result, the highest points of interproximal bone should be reduced with a chisel to conform to (or at least approximate) the height of the adjoining bone crests. Bone reduction is also indicated when there are interproximal depressions (concavities extending rootward at the crest of the alveolar septa) which permit the cortical plates to stand higher. Unless the plates are reduced to the lowest level of the depression, a pocket will be present until the teeth are lost.

An essential part of the treatment is protection of the areas operated upon by the use of a suitable surgical dressing. The principal ingredients of this material are zinc oxide and rosin, in the powder, and oil of cloves and olive oil, in the liquid. If excessive bleeding is a possibility, tannic acid powder may be added to the mixture for its hemostatic effect. The main objects in using this dressing are the minimizing of postoperative pain and discomfort, protection of the regenerating tissue and desensitization of the denuded areas of cementum. Before the packing is placed in position, phenol may be applied to the surfaces of the incised tissues in order to inhibit granulation.

Contrary to common practice, the dressing material should be mixed to a very thick consistency; which greatly reduces the difficulties of manipulation and application. It is very important that the interproximal spaces be compactly filled with the packing, as most of the postoperative pain, if any, emanates from this source. It is also desirable that the dressing remain in these spaces longer than elsewhere in order to "hold down" the bulk of the regenerating tissue and prevent it from reestablishing a pocket.

First, a small amount of the packing is forced toward the contact point with the packing instrument into the interproximal spaces from the labial or buccal side, until it appears on the lingual side. Then sufficient material is molded into narrow rolls of desired length to cover the labial, buccal and lingual borders. This roll, a section at a time, is set in position along the ridge, being retained in place by adhering to the interproximal material. An excess of the dressing should be avoided so as not to be cumbersome and possibly interfere with the bite. The duration of the packing is dependent on the depth of the excised tis-

sue and varies between ten days and two weeks.

Upon removal of the packing, the granulation tissue should be stimulated by proper brushing. A section of rubber sponge wrapped around a toothbrush handle serves this purpose. As a dentifrice, equal parts of sodium chloride and sodium bicarbonate have a desirable effect upon the granulation tissue which originates from adjoining normal and healthy tissue. This tissue readily responds to proper care, but will quickly become inflamed if neglected. It is scar tissue, but, in a very short time, it is not distinguishable from normal tissue in appearance, contour, texture, color or function. Microscopically, it cannot be distinguished from healthy mucoperiosteum.

When the tissues have healed satisfactorily, regular brushing, with the Charters' method preferably, should be instituted. Thorough scaling with Younger type scalers should be followed by polishing of the necks of the teeth with a porte polisher and tape, finishing with adequate prophylactic care of the crowns. It must be understood that all known local and general etiologic factors should be corrected wherever possible. Periodic examination and prophylactic treatment at regular intervals are necessary adjuncts to home care for maintaining the oral tissues in a state of health.

The justification for the method described is based upon the following premises:

1. Once a periodontal pocket or lesion has become established, it will remain until eliminated. It is self-perpetuating, promoting retention of calculus and food débris and providing an ideal nidus for the propagation of bacteria. Because of irritation from its contents, the pocket constitutes an aggravating influence for its own further development and progress.

2. The internal surface of the outer wall of the pocket, partially or completely stripped of epithelium and exposing the blood vessels within the underlying connective tissue, provides the medium through which bacteria and their toxins can gain ingress to the circulatory channels and surrounding tissues. This physical set-up establishes the periodontal lesion as a potential or an active focus of infection.

The first premise is based on the grounds that so-called "reattachment," which presumes the union of a living tissue with a non-vital one, is a biologic impossibility. Living connective tissue cannot be made to unite with non-vital cementum. Kronfeld has stated that the deposition of living cementum upon a necrotic surface, as presented by denuded cementum after exposure to infection for months or years, is not likely to occur.[1] To enable "reattachment," it would therefore be necessary to have a layer of vital cementum for the attachment of the connective tissue fibers. In the event that such a phenomenon did occur, the growth of epithelium over connective tissue is so rapid that it would be physically impossible to maintain the apposition of connective tissue fibers to cementum long enough without the intrusion of epithelial cells to hinder their physiologic insertion.

After years of argumentation and effort, the only evidence cited in support of the theory of "reattachment" in a recent textbook in periodontia was the report of a specimen supposedly showing epithelial attachment to dentin. Some dental histologists who have examined the section are not certain whether apposition or attachment exists between the two tissues. Even if the alleged reaction did occur in a small percentage of all cases treated by instrumentation, the use of this method to the exclusion of other procedures would still remain unjustifiable in view of the unpredictable results. Admission that the desirable achievement in periodontal treatment is closure of the pocket does not in itself warrant upholding unscientific claims for

unattainable results. Such advocacy obstructs the progress of periodontal therapy.

The second premise deals with what may be termed the most important, as well as critical, phase of periodontal treatment, the thorough elimination of all infected structures forming and adjoining the pocket (all of which constitute a focus of infection) and capable of jeopardizing the general health either through lowering the vital forces or initiating foci in other parts of the body. Far too little attention has been given to systemic conditions caused by degenerative changes within the periodontium. The apical granuloma is generally given greater consideration than periodontal disease.

Our principal concern with periodontoclasia seems to be only alarm over its effects upon the mechanism supporting the teeth. From a histopathologic standpoint, it should be evident that no other oral infection involves such extensive and unprotected areas of both soft and osseous structures in intimate relationship with circulatory channels as do periodontal infections.

We should also bear in mind the time element in these pathogenic changes, considering the many years that intervene between their incipient and advanced stages and the infective processes that are constantly active.

Hartzell, Simms, Henrici, Thomson, Fisher and others demonstrated the presence of streptococci in every case of this disease.[2] Beckwith also demonstrated this same organism within the tissues and closely adjacent to the lymph channels.[3] Streptococci can be seen in stained sections well beyond the ulcerating surface of the gingival crevice.[2] The pathogenicity of streptococci from periodontal exudate has been repeatedly demonstrated.

We should also be apprehensive regarding the toxic elements that are ingested with food. Cook and Stafne, using 100 strains of streptococci from twenty-five patients with secondary symptoms (arthritis, iritis, colitis, nephritis, duodenal and gastric ulcers and cholecystitis), also demonstrated a specific localizing power.[4]

In the work carried on at San Quentin Prison by Boyens and members of the California Academy of Periodontology, the studies of the blood picture in periodontal infections brought out the following: 1. Gibson's chart indicates increased resistance of the host after treatment. 2. Toxic degeneration of neutrophils as expressed by fine granulation is decreased after operation; which points to diminished toxic absorption. 3. The incidence of indicanuria is less after operation.[5]

The medical staff which examined the inmates before and after treatment of periodontoclasia by surgical procedures reached the following conclusions: 1. The symptoms of about 75 per cent of the patients with complaints were alleviated after treatment. The more common symptoms were stomach ailments, headache, nocturia, fatigue, nervousness, constipation, restless sleep, backache, dizziness and poor appetite. 2. There was no clinical evidence of systemic injury to the patients after the surgical treatment. 3. A close relationship must exist between periodontoclasia and systemic conditions. 4. Periodontoclasia should always be regarded as a danger to general health.[6]

Medical science is handicapped in physical diagnosis by not having an index to ascertain whether a focus of infection, irrespective of its location, is causing a reaction elsewhere in the body. Yet the everyday clinical experience of many dentists and physicians demonstrates that systemic symptoms have often disappeared upon the complete eradication of periodontoclasia. Many of these symptoms were of major disorders. It has also been noted that individuals not afflicted with specific systemic symptoms usually feel better and improve in appearance after being treated surgically

for periodontoclasia. In such cases, the toxic effects of absorption from the periodontal lesions must undermine physical resistance and general tone.

In the light of the foregoing arguments, it would not appear reasonable that, in treating diseased periodontal structures, we stop at half-way measures and leave in the mouth tissues which cannot be termed normal or healthy; which would be comparable to allowing similar chronic inflammatory tissue to remain in apical regions, with the resulting formation of residual areas. It is therefore quite logical that the periodontal lesion in its entirety, with all contiguous diseased tissue, be eliminated and that new and healthy tissue asuming normal relations be allowed to replace these pathogenic entities. The prevalent fear of removing too much soft tissue should be alleviated by the fact that Nature, in her defense mechanism, provides protection against such contingencies. Should any excess of soft tissue be removed from a point beyond the alveolar border, on either side of the ridge, there will be immediate regeneration, with no impairment.

The bottom of the periodontal pocket will generally be found a few millimeters away from the surface of the alveolar process with an attachment of connective tissue to cementum from the limits of the lesion to the level of the osseous structure. Some dental authorities have advanced the hypothesis that this soft tissue, below the pocket and overlying the process, contains elements of bone which might regenerate and heighten the crest of partially destroyed alveolar structure and, for this reason, they advocate that it be retained. As previously stated, it is a demonstrable fact that this tissue, invaded by bacteria, is adherent to alveolar process and is drained into that structure.

In our practice of removing this tissue, it has been found that it regenerates and reattaches itself to its former base as a healthy tissue. The attachment of the regenerated tissue is possible only because this segment of cementum is vital. Therefore, the normal relationship of this tissue is not altered by the operation. Clinically and from roentgenographic evidence, in many cases, when the removal of this tissue has been effected and the ridge of alveolar bone left clean and smooth, a new layer of cortical bone has formed which outlines the surface of previously cancellous structure. Would it not be reasonable to assume that it will be time to modify this practice only when dental scientists present us with definite data regarding regeneration of this tissue into bone and explain under what conditions we may expect such favorable reactions?

In the final analysis, leaving aside all hypothetical questions for further research, and considering only actual knowledge, supported by clinical confirmation, we must concede that symptoms of retrogressive and degenerative changes within the periodontium attend all manifestations of periodontoclasia and that these changes are not generally subject to regenerative transitions leading to a return to the normal. Our final goal, in the treatment of periodontal diseases, under present knowledge, may be defined as the arrest of any further pathologic changes within the periodontium and restoration of its tissues to a state of health. Clinical experience demonstrates that rational surgical procedures more closely approach these results than do other forms of periodontal therapy.

In conclusion, it may be stated that surgical treatment, as herein outlined, presents the following points for serious consideration:

1. In the removal of any organic tissue, the knife offers the most accurate and controllable means of operation.

2. The surgical method offers the most expeditious means of treatment. An en-

tire mouth may be operated upon at one sitting if this is desirable.

3. It completely eliminates the periodontal pocket, which is replaced by healthy tissues and a gingival crevice of a normal depth, which can readily be kept in a favorable hygienic condition.

4. It insures the thorough eradication of all pathogenic processes that make up the disease entity periodontoclasia and thereby removes from the oral cavity a serious menace to health.

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# TRADITION AND ITS EFFECT ON PROGRESS IN FULL DENTURE PROSTHESIS

By Russell W. Tench, D.D.S., New York, N. Y.

THE last three decades have brought to dentistry a scientific background and tremendous improvements in the technic of repair and restoration. The young of today have better teeth and need less extensive restorations than those of thirty years ago. This is due to dental research and dental teaching.

Dentistry today is able to provide better functioning and more agreeable appearing restorations of all kinds. However, every advance in dentistry's ability to serve the public has required more of the dentist's time and greater skill than was required by operations intended to serve the same purpose thirty or forty years ago. The only exception is the gold foil restoration.

Read before the Section on Full Denture Prosthesis at the Eighty-First Annual Session of the American Dental Association, Milwaukee, Wis., July 18, 1939.



Tradition has fixed in the minds of the public standards for dental fees adequate for the less scientific dental care of a generation or two ago, but inadequate for such service as modern dental progress has made it possible to provide today.

We have thus, on one side, progress in dentistry's ability to serve and, on the other, an almost static condition of public appreciation of this progress. The result of this unequal situation in far too many practices is probably to withhold the fruits of modern dental research and progress from that part of the public who really desire better service. Professional men are not, as a body, adept enough in argument or skilled enough in presenting the facts in an acceptable or convincing way to be individually effective in correcting this situation.

The instinct to survive by following

the line of least resistance is universal in dentistry, as it is in any other field of human endeavor. The statements "My patients won't pay for such service" and "I'll give them what they want" express the hopeless frame of mind of many of the profession resulting from their attempts to raise fees to a level comparable with the increased cost to the dentist of adequate scientific modern dental care.

Thus, the net result of tradition, in the average or low income group practices, is to retard the application of modern dental knowledge to the needs of the public.

The public cannot have the facts unless dentistry gives them to it. We have as an organized profession done much to impress the public with the need for and necessity of adequate dental care. We have, on the other hand, been very neglectful in failing to acquaint the public with the fact that the valuable, more efficient, more enduring dental service possible today cannot be provided on the basis of the traditional compensation of yesterday.

To put it in other words: Today, dentistry's potential ability to serve the public well and enduringly has far outstripped the public's appreciation of this ability in terms of dollars and cents.

Thus, tradition is retarding progress in dental health service. Organized dentistry really should lay aside its cloak of professional pride and provide the public, to which it owes its existence, with the facts of the situation.

All of the evils which threaten or seem to threaten the even tenor of dentistry's progress can be directly traced to the short-sighted economic error of trying to devise ways and means of fitting the service to the inadequate traditional fee level of the past, rather than pursuing an organized effort to uphold the highest standards of service by fitting modern fees to modern service.

It requires great courage to permit a potential patient to walk out of one's office just because he has been permitted to form wrong opinions of the value to him of conscientious, careful service at a life-sustaining fee. It takes great courage to let patients walk out when we know that they will not have to search either long or far to find another dentist, perhaps economically at bay, who has been beaten down to giving the public shoddy, inferior service at the fee that it will pay. Of course, both the patient and the conscientious dentist suffer as a result of this situation.

I shall not dwell on the fact that there are too large a number of dentists morally and physically unfitted to practice dentistry at all.

The time is ripe for our department of public relations to correct this sad condition. The time has come when we should make a serious beginning at dealing with the problem of educating the public concerning the economic waste and ill health that result from cheap dentistry. Those who have the interests of the public and dentistry at heart should be able to produce more material for state and national dental associations' programs which will be reported in the press and will stress the value to the patient of taking as serious and honest an interest in the economic welfare of the dentist as the patient expects the dentist to take in his dental welfare.

Now, all this leads up to a specific consideration relating what I have said to matters within the scope of this prosthetic section of the American Dental Association.

We in the field of prosthesis suffer from the canker of tradition more than does the general practitioner in his work fields. This is particularly true of the full denture field. The farther we have progressed in skill and knowledge of full denture prosthesis, the more apparent have the defects in our traditional methods of dealing with the public become.

Go into a community of a few thou-

sand population, anywhere in the United States, and you will find that there is a definite fee, set by tradition, for which a set of dentures is made. That is why the use of new denture materials, new types of teeth or gold, or some other explanation, is common among dentists in an effort to obtain a more life-sustaining fee. In a sense, this is justifiable, commercially, but the fee from the professional angle should be based on the service rendered rather than on kind, or cost, of materials used in performing the service.

This custom of setting a fee of so much for one denture or two of them was probably justifiable thirty or forty years ago, because methods were then crude and results uniformly mediocre. When dentures did not "work," no one could tell whether the patient or the denture was at fault. Thirty or forty years ago, rush methods involving quantity production produced just about as good dentures as more deliberate procedures.

Today, conditions have changed. The science of building artificial dentures is an exact one, as far as the dentist's part is concerned. It has become evident that the patient is a variable and unpredictable element in the picture.

Patients come to the wearing of dentures today at a later period of life, if they do not evade it altogether. At least, those who have had efficient dental care do.

Thirty or forty years ago, the patient was not so unpredictable a part of the picture as he is today, since dentures were then resorted to from fifteen to twenty-five years earlier.

Young persons are a better health risk and are more adaptable than older patients. Denture patients vary in many ways, some of which are predictable. Patients vary in a predictable way in the size, shape and relation of ridges. They vary in an unpredictable way in general health, in local resistance of the mouth tissues to either traumatic or normal functional pressure, in adaptability, in speech and masticating habits and in acquired or normal positioning of the mandible.

The moment dentures are inserted, these variables become evident and begin to exert their influence.

Up to the time that dentures are inserted, the routine is similar for all patients, no matter what conditions are known to exist. Up to this point, it is logical and just that fees for good dentures be the same in all practices of the same community.

Many sets of dentures are made that need little correction after delivery. On the other hand, a considerable number of denture patients must have a great deal of after-attention and coaching before they are able to wear dentures comfortably, and a few have tissues so debilitated that a state of complete comfort is impossible. Rebasing, changing the vertical dimension or making corrections to restore the true occlusion after a false one has been acquired, which, in the beginning, appeared to be true; or continual spotting of the occlusal surfaces and relief of the base of the dentures to compensate for settling are not infrequent, especially for those older patients who lose their teeth in the hope, sometimes realized, of improving their general health. My patients who "put them in and never touch them" have invariably been under 30 years of age. My patients who "put them in and must constantly be seen for after changes" have most frequently been over 45 years old. Between the ages of 30 and 45, one may find a few of the type needing much after-attention.

As a profession, we need to take cognizance of these patient variables that require prolonged care. We must inform patients of the possibility of prolonged after-treatment and must make provision for their payment of the bill if such service is needed. If we were to adopt this plan, we might find it possible to

reduce the initial fee for all dentures at the time of delivery. It is the unpaid-for time, spent on after-adjustments, that often takes the joy out of life. At the end of many a month of continuous application at the chair, we find the financial situation unsatisfactory if we have one or two of the variety of patient who pays his bill, half at the beginning and the rest when the dentures are delivered, and after that requires as many more hours of free adjustment service as were required to build the dentures.

A fee for the delivered dentures and for four to six visits for after-attention should be set, and if more visits are required, each visit or operation should be charged for at the established office fee. This has the effect of relating income to time devoted to practice. This plan has the effect of helping certain patients to endure minor irritations, which usually correct themselves. These patients do not ask for unneeded attention if they are expected to pay for it. The plan also maintains the patient's confidence.

If you were a denture patient, and after the dentures were inserted and paid for, the dentist had to continually modify and change them, would you believe him if he told you that these changes were due to your physical condition or ridge relation, etc.? Or would you perhaps suspect that he was not a well trained operator and was trying to remedy the errors he had made? What does the patient think? Can you not see that our present plan of setting a flat fee, and for this fee sometimes making endless unanticipated but necessary changes, is unfair not only to the dentist, but also to all dentists and the public, in the end? It is unfair because it is founded on a false premise; viz., that all people are alike, and a good dentist can make comfortable dentures for any of them, with no more after-attention for one patient than for another.

This situation will never be corrected unless we do something about it. All patients must be informed at the first interview that there are involved in denture wearing hidden conditions impossible of detection at first, although suspected, and which may require more of the dentist's attention in some cases than in others.

With this start and an arrangement involving fees for the amount of service that may be necessary, the operator is in a position to command the respect and cooperation of the patient rather than to be suspected of incompetence.

It goes without saying that all relations of dentist to patient should be on the basis of honesty and utmost fairness. The dentist recognizes the fact when his part in the relationship is properly done. The patient should not be led into paying for the dentist's mistakes; and the dentist should not be obliged to bear the burden of caring for hidden, unpredictable complications without compensation.

The public is entitled to know that modern, greatly improved dental care is to be had only at an increase in cost, and if we take the public into our confidence, the improvement in dental service will result in great economic and health benefits to the public which dentistry serves and to which it looks for its livelihood.

745 Fifth Avenue.

# HOW CHILDHOOD FEARS TOWARD DENTISTRY CAN BE CONTROLLED*

By GEORGE E. MORGAN, D.D.S., Milwaukee, Wis.

THE problem of controlling child behavior in the dental office differs markedly from the ordinary problems of child psychology in the home and the schoolroom because the child is not subjected to conditioning by group influences and because he has frequently acquired damaging environmental attitudes toward dentistry. Too often, intelligent adults feel that the responsibility for guiding the child to wholesome attitudes toward dental health services is the sole responsibility of the dental profession and its allied workers. However, that idea is founded upon fallacy and misunderstanding, since the task of determining the child's life and health patterns is the common responsibility of humanity, and the sooner it is accepted as such, the easier it will be for the child to meet such situations as those experienced in the dental office.

According to a dental survey of school children between the ages of 6 and 14 that was conducted in twenty-six states by the United States Public Health Service in conjunction with the American Dental Association, approximately 97 per cent of school children are in need of dental care. Therefore, dental decay can be said to affect the great majority of mankind; and we know that dental disorders, if neglected, become progressively worse. Dental defects can be corrected only by a dentist and dental health service should be looked upon as a common experience and not the traditionally branded ordeal which mankind must fear and avoid.

Frequently, parents ask me what they can do to condition the child to dental care. May I say here that this is a sensible question and one that should be asked not only by parents, but also by school teachers and other adults. Psychologists generally agree that the child has only three recognized behavior patterns at birth. These are expressed in the following emotions: (1) fear, from sudden loss of support or on hearing a loud noise; (2) rage, from having movement hampered, and (3) love, arising from tickling, having the skin stroked, rocking and patting. Therefore, fear of dental care is not natural, but acquired. It is usually the outcome of the child's first impressions and attitudes in the home, which later are modified by his own or others' experiences. The parents' and the school teachers' reactions are often the child's greatest handicap because the responsibility for the child's dental health and happiness is still the privilege of the home and his attitude can be wrongly influenced by the school.

Unthinking parents and friends, by talking about the horrors of dental operations, rather than stressing the benefits of dental health, become responsible for children's fears. Some adults, as a disciplinary measure, threaten to take the child to the dentist for treatment. Such reasoning produces a negative response toward dentistry and warps the child's perspective. Furthermore, it is natural for children to confide in those near and dear to them; and while the practices of child health are matters of common knowledge to parents and school authorities, it takes more than common knowledge to keep the child's adjustments toward dentistry healthful. Therefore, it should be our ul-

*A radio talk from the Department of Pedodontia of Marquette University, School of Dentistry, given over WTMJ, the Milwaukee Journal station, December 16, 1939, as a part of the university's series of educational broadcasts.

timate aim to so train the child that he may accept dental health service as a gift to civilization; for the fears of childhood are the forerunners of adult fears.

Most children are placid and they accept dental care as they do other things in life, with a matter-of-fact attitude. On the other hand, some children exhibit a recognized behavior pattern under a given set of conditions. Many years of observation and experience, exclusively with children, leads me to believe that three types of personality patterns present a problem of management from the standpoint of dentistry:

First, the timid type, observed in the child who demonstrates no perceptible initiative, cannot play successfully with other children and finds it difficult to amuse himself when left alone. This type is usually inactive in the dental office, sits quietly near his mother, looks to her for entertainment and portrays no confidence in himself. His timidity may have several sources: 1. He may be an only child. 2. He may receive too much attention at home and be the typical "baby." 3. He may be a sickly child, with the result that he has had many unpleasant experiences with physicians, nurses and hospitals. 4. He may be the undernourished child, often referred to by his mother as a "poor eater."

Second, the bully or obstinate type who possesses an overabundance of "drive." He is usually an inveterate bluffer. Outwardly, he appears courageous and puts forth great effort to impress others with his importance. In the dental office, he is active, amuses himself, and pretends to be unconscious of his surroundings. When invited into the operating room, he walks in quickly, seats himself in the chair and by his actions almost says, "I am not afraid of you, but you had better be of me." His blustery manner, an outward defense mechanism, may have several sources: 1. He may have had an unpleasant dental experience. 2. He may be accustomed to having his own way. 3. He may be the victim of great expectations in his home and school and as a result has acquired a grandiose type of personality.

Third, the shy or bashful child who suffers from lack of courage. This type becomes afraid when a situation is so new, so strange, that he has no means of interpreting it. He says little or nothing to strangers and tries hard to conceal his mental conflicts. In the dental office, the child of this type often walks into the operating room trembling and ready to burst into tears. He usually displays no activity in the reception room and appears uninterested in everything about him. He is the forgotten child in the home and his shyness is the outcome of having too few child companions, with little opportunity to condition himself to new surroundings and strangers, or with gradual impairment of his general health, resulting in a marked lowered resistance. The shy or bashful child is usually of school age, and his conduct indicates the childhood symptoms of an inferiority complex and an introvertive type of personality.

A child's reasoning power tells him that tactics which bring results at home will also work with the dentist. If he uses defense mechanisms to avoid a new or strange situation at home, he will attempt to meet the demands of the dental office in a similar manner. The most common defense mechanism is crying at the top of his voice; but as perplexing to the parents are tantrums in the form of coughing, choking, refusing to get into the chair by throwing himself on the floor, playing sick, wanting to vomit and holding his mouth tightly closed. Of course, these adjustment responses are not unusual, since all children are by nature rebellious. If the parent is perturbed by the child's reaction, it merely adds to the difficulty of guiding the child to accept dental care as a part of his life. My advice to these parents is to cooperate with the dentist by remaining in the reception room, thereby allowing the dentist to command the situ-

ation and, through methods of recognized procedure familiar to dentists, motivate the child to cooperate. The control methods will be dominated by kindness and consideration, since the dentist realizes that praise is much more effective than censure.

Parents should understand the emotional growth of children sufficiently to realize that during the preschool years, preferably at 3, the child is easily conditioned because his personality is most pliable and flexible. This period of childhood is the age at which to develop the necessary healthful attitudes and is an opportune time to acquaint the child with the benefits of dental care.

One of the greatest bugaboos in the fear states of children toward dentistry is the lack of cooperation with the dentist on the part of the parent and the school. The play motivating influences of the classroom are not effective in the dental office as the objectives of dentistry cannot be accomplished. Teachers and principals often do not realize the great need for dental health service among children and how dental disease affects the teaching-learning situation. A plea for more lenient attitudes toward absentees for health purposes is not amiss, as intelligent people should realize that the health of children comes first and their education second. Children respond more readily to a new situation early in the day when they are well rested. Therefore, common sense should tell us that it is advisable to arrange an early morning appointment for all young children. Then, too, the child's first visit to the dentist should not be longer than one-half hour, and, for the benefit of the child, something constructive should be accomplished during each visit.

Another question mothers often ask is: "Why do children's teeth decay?" If I could answer that question, I would startle the world; for nowhere on this universe has that mystery been solved. The Research Commission of the American Dental Association has just published a compilation of 195 summaries from the findings of living investigators of twenty-five countries on the cause and control of dental decay. It has been concluded that decay of the teeth may have several sources; that dental decay is primarily a disease of childhood which is often carried into adulthood through neglect; that dental decay begins at the outer surface of the tooth and burrows inward until it reaches the pulp, or core; that dental decay is cumulative and spreads from tooth to tooth, and that dental decay can be checked only through early periodic treatment by a dentist.

Since dental health service has been unjustly labeled a painful operation, and since fear is our protective mechanism, it is well to remember that pain is the penalty of neglect and freedom from pain the reward of prevention. We know that all treatment is painful when the diseased condition has become critical. In dentistry, the axiom "A stitch in time saves nine" can be prescribed as a control procedure to lessen pain and eliminate fear.

In conclusion, may I emphasize that (1) childhood fears toward dentistry are not natural, but acquired; (2) these fears can be greatly alleviated by close cooperation of the parent, the child, the teacher and the dentist, each understanding the problems of the others; (3) pain as the result of neglected decay is a factor in fear; (4) no cavity is too small to fill and all teeth are important; (5) nowhere in the world has dentistry attained a higher standard of health service than in the United States; (6) the thirty-nine dental schools in the United States are now giving their students special instruction in the care of children's teeth, and (7) dentistry for children is not a luxury, neither is it an expensive necessity, if care is provided early, regularly and systematically, since the more complicated conditions can be prevented.

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# WHY NOT SAVE THE PULP INVOLVED TOOTH?

SOME two decades have now passed since the profession became hysterically employed in the removal of all teeth in which the pulp was in any way involved—diseased, dead or absent.

The incidents leading up to this fatalistic attitude on the part of the dental practitioner were numerous, but almost wholly without confirmed scientific reason. In 1910, William Hunter, a dentist of London, proclaimed the theory that oral sepsis had much to do with systemic conditions, which, in many instances, became serious, and even fatal; that dental restorations were largely responsible for the oral sepsis, and that the mechanical perfection of what was known as American dentistry was responsible for the indiscriminate manner in which mechanically perfect restorations were being placed upon pulpless teeth.

The pulpless tooth tocsin was readily approved by the medical profession of America, and soon, to the destruction of the masticating apparatus, the hundred per cent cult was born in both the medical and the dental profession. And although this theory had been advanced long previous to Hunter's diatribe, it seems that the revival of the idea struck a psychologically hopeful chord in medicine as promising an explana-

tion of many of the more or less intractable conditions that the physician had thus far been unable to account for.

Then, too, the mechanical aspect of dental practice was rapidly nearing the height of its popularity. Dentists were overenthusiastic in the application of new and varied mechanical principles which involved the destruction and removal of teeth and pulps, and so enthusiastic were they in the application of these new mechanical methods that all biologic principles seemed to become subordinate to those of mechanics. The revelations of Hunter were but the signal for a reaction that was destined to swing the pendulum as far or farther in the direction of removal of all these teeth that had been sacrificed for abutments and as many others as might be even suspected of being the cause of oral focal infection.

The enthusiasm with which this theory was pursued and the nature of it, as would be expected, developed much evidence that apparently confirmed the suspicions. With the passing of time, however, and the development of much contradictory evidence, a skepticism developed that resulted in an introspective attitude on the part of dentistry, impelling it to seek a sane and safe position and one that would be tenable as leading to the saving rather than the extraction of teeth.

Though discouraged by the attitude of many, in fact, most medical men and many of the dental profession, there were those in dentistry who still believed that many of the teeth that were being extracted could have been saved and restored to usefulness and retained without jeopardizing the health of the patient. And these men proceeded to confirm their beliefs clinically and scientifically.

As with any theory of disease that requires the time element to establish its soundness, long years of clinical trial and, unfortunately, error passed before the desired evidence and proof were forthcoming. In the meantime, the ranks of the "hundred percenters" were being augmented by reports of cases in which miraculous cures of systemic diseases were experienced through the removal of teeth which had been the initial cause of the systemic ailments.

On the other hand, clinical experience was gradually proving that many diseases which had been attributed to dental sources did not respond favorably to the removal of the suspected teeth; that other conditions and organs of the body were equally involved in the focal infection expression, and that the loss of the suspected teeth had greatly retarded the recovery of the patient.

The efforts of the dental research workers who had been at work assiduously to devise ways and methods that would assure a sane procedure for restoring pulp involved teeth were finally rewarded with success, and today the fact that the pulp involved tooth can be restored to usefulness, and without menace to the health of the patient, has been indubitably established. The vital principle involved in all the procedures that have proved successful has been the well-known cardinal principle upon which successful surgery is based—asepsis.

The difficulties to be surmounted in the successful treatment of teeth which have lost their pulps are such as to discourage any but the most optimistic and stoutest-hearted operator; and these difficulties are to some insurmountable, but it has been definitely determined that, difficult as it is, it is still possible to perform root-canal surgery under such surgically aseptic conditions that the tooth can be safely saved.

Rhein, Callahan, Grieves, Coolidge, Prinz, Walker, Howe, Rickert, Johnston, Hatton, Blayney, Waas, Grossman and numerous other root-canal workers have demonstrated the fact that beyond a doubt a tooth in which the pulp has become involved is not necessarily a "dead" one. In our present issue, we present one of the most exhaustive and scientifically sound studies of the problem that have thus far been presented, the paper by Drs. Sommer and Crowley, which should dissipate finally all doubt as to the ability of the dental operator to save the pulp involved tooth.

There are, however, other questions than that of asepsis involved in the successful management of pulp involved or pulpless teeth. First and foremost is the judgment of the operator as to the selection of the teeth in which the procedure should be attempted; second, the ability of the operator to meet the demands of such an exacting operation; third, the age and condition of health of the patient; fourth, the appreciation on the part of the patient of such an effort, and, fifth, the economic warrant in the individual case. Of these, by far the most important are the skill of the operator and his judgment as to the advisability of the operation in any individual case.

As the years have passed, and as we have watched the vacillating tendency of opinion toward these tooth-saving efforts, we are quite firmly convinced that progress toward a solution of this problem has been seriously impeded by well-meaning operators attempting to save teeth about which they themselves were doubtful before the attempt. Such attempts could result only in failures and the implications of these

failures have emboldened the medical man to assume a more or less dictatorial attitude in the disposition of cases in which the teeth are suspected of being remotely related to the etiology of a given systemic condition. The consequences attendant upon this course have led to the making of so many dental cripples, with no compensating relief, that both the medical practitioner and the dental practitioner are rapidly revising their estimate of the great benefit to be derived from the indiscriminate removal of any and all teeth in which the pulps are involved.

Some of the medical internists have so far revised their thought on the subject that they are beginning to question the causal relation of oral focal infection in systemic disturbances.

Such a position as that just noted, however, is just as untenable and as much without justification as the antithetic one that oral focal infection is responsible for virtually all systemic irregularities.

We believe that several definite and logical conclusions can safely be drawn from the varied experiences and from contrasting opinions on this subject; namely, that, in numerous instances, the teeth do have a causal relation to systemic disease; that, in numerous instances, the teeth do not have a causal relation to systemic disease; that teeth with the pulps involved, as well as pulpless teeth, can be saved for many years of healthful usefulness; that all pulpless and pulp involved teeth cannot be saved; that all pulpless teeth should not be removed; that the question as to whether an attempt should be made to save a certain tooth should be left to the judgment of the dental operator in collaboration, or not, with the physician, and that the final determining factors should be the present health status of the patient and the degree of skill of the operator, based on long clinical experience.

From almost the very inception of the belief that pulpless teeth were a dangerous source of infection, we have felt that the pioneer research work of Clarence J. Grieves, of Baltimore, furnished the key to the solution. Dr. Grieves believed and scientifically supported the belief that classification of the conditions about and in the root canal would enable the operator to determine in which cases therapeutic measures might be successfully instituted, and his clinical experience, even in the early days of the extraction fad, enabled him to apply such a classification and successfully manage pulp involved and pulpless teeth.

And finally, while we are duly impressed with the possible serious results of oral focal infection, we are convinced, from the clinical experience of the profession, that the average skilled dental practitioner is capable of successfully applying the technical skill and the aseptic prin-

ciples demanded for the treatment of pulp involved teeth, and in a manner that will assure the preservation of the teeth as useful and necessary organs of mastication.

## A NEW INDEXING FEATURE FOR THE ASSOCIATION ACTIVITIES SECTION

In an effort to supply an apparent demand on the part of our readers and members for more elaborate and definite information regarding the affairs of the Association, and especially the activities in the Central Office, we have accordingly much enlarged both in content and scope the section devoted to the activities of the Association.

We have also inserted a special contents page as a guide to the section, and have devised a means for readily locating this contents page. On the outer edge of the contents page at the beginning of the Association Activities Section, we have placed three black half circles, which, when the edge of the magazine is fanned, will readily indicate the contents page.

We trust that our efforts may result in an increased interest in association news as well as more ready accessibility thereto.

## BIBLIOGRAPHICAL

**The Story of Dentistry**

By M. D. K. Bremner, D.D.S., F.A.C.D. 210 pages. Illustrated. Cloth. Price $3.75. Dental Items of Interest Publishing Co., Inc., Brooklyn, N. Y., 1939.

This interesting book carries one briefly through the history of dentistry from earliest times to the present. The volume begins with an account of the existing evidence that dental diseases have always been with the human race and traces the development of dentistry and dental treatment through prehistoric times, the Greek and Roman eras and the Middle Ages. With Fauchard, the beginnings of modern dentistry are discerned, and, in the latter portions of the book, considerable space is devoted to the development of various dental procedures. Short interesting biographic accounts are given of many of the outstanding men who contributed so much to dental science and art during this period of development. Throughout, an attempt is made to integrate the development of dentistry with the social history of the period under discussion. This manner of presentation offers an excellent opportunity for the reader to gain a general impression of the thought and action of the period. The portions of the book dealing with the technical developments in dentistry are particularly interesting and well done.

Considerable attention is given to the development of the cast gold inlay and the extensive litigation involved by Taggart's patents. Dr. Bremner played an important rôle in the development of the Dentists' Mutual Protective Alliance, which finally gained the

decision over Taggart, and it is evident that he is on familiar ground in this section.

The book is well written and the material is interestingly presented. It can be heartily recommended to general practitioners and students as an aid to better understanding of the development of the profession to which they are devoting their attention.

## Human Pathology

By Howard T. Karsner, M.D., Professor of Pathology, Western Reserve University, Cleveland, Ohio. Fifth edition. Cloth. 1013 pages with 433 illustrations. Price $10.00. Philadelphia and London: J. B. Lippincott Company, 1938.

The widespread use of this textbook has necessitated a fifth edition. In the realm of competition among the better treatises on pathology, both the medical and those concerned with a more generalized knowledge for the dental student, this book has successfully maintained its popularity and has gradually gained in favor over many of the others.

The volume is divided into two sections. The first deals with general pathology. The second section is concerned with special organ pathology and is in accord with the conventional division adopted as a result of long teaching experience. In the present edition, no chapter has escaped alteration. The extent of revision is partially indicated by the fact that nearly 250 new references have been inserted and many older references deleted. Several new illustrations have replaced older pictures and six new plates have been inserted to amplify the text. All are precise and appropriate. Specimens gathered from the Army Medical Museum have aided materially in this respect.

Schematic outlines for topic discussion are presented at the beginning of each chapter in tabular form so as to give each subject its relative position in the entire treatment. Pathologic processes are taken up in a systematic manner, preceding from the general to the particular, covering the various phases of the work in such a way that the beginner is not confused and yet allowing the specialist to make a ready check on some doubtful point. Although the discussion of debated or intricate subjects is sufficient to permit definite understanding of the points at issue, the author has made use of the valuable method of supplying well-chosen references for those engaged in the enlargement of their field of knowledge, allowing access to original sources and a more comprehensive examination of topics that cannot be encompassed in a textbook.

New developments in pathology are included in the book. The discussion of pathologic pigmentation now emphasizes the significance of pulmonary silicosis. Fatty metamorphosis is presented in the light of much recent study. Amyloidosis has been reclassified and the discussion clarified. In the section on circulatory disturbances, the newer views on edema, thrombosis and pericardial adhesion have been included. There is also new material on inflammation and tumors. Circulatory disturbances and cardiovascular disease are covered, with an appreciation of the abnormal physiology involved. In summary, the volume is a textbook of pathologic anatomy and histology based upon and integrated with the more basic concepts of disease as related to all the biologic sciences.

V. D. C.

## Food Values of Portions Commonly Used

By Anna de Planter Bowes, M.A., Director, Nutrition Education, Philadelphia Child Health Society, and Charles F. Church, M.D., M.S., Formerly Associate in Pediatrics, School of Medicine, University of Pennsylvania. Second edition. Paper. 31 pages. Price $1.00. College Offset Press, Philadelphia, 1939.

This pamphlet consists entirely of tables giving in detail the composition of average portions of commonly used foods, including the vitamin content. It should be helpful to those preparing diets of a certain caloric content, or carbohydrate content, as for diabetics.

# ASSOCIATION ACTIVITIES

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# President's Message

## RESEARCH ACTIVITIES OF THE AMERICAN DENTAL ASSOCIATION

THE purpose of these presidential messages, as indicated in the first message, published in October 1939, is to inform the membership of the many activities carried on by the American Dental Association in the interests of the profession and the public. Notwithstanding the fact that the American Dental Association holds an annual meeting somewhere in the United States to which all members are invited, and publishes a journal containing information as to its activities, the rank and file of the profession are not in regular attendance at these meetings, and probably do not read each number of THE JOURNAL from cover to cover. They can hardly be expected, therefore, to be informed as to the multitude of activities carried on by the Association. With a view to keeping them in closer touch with these activities, and in the belief that an informed membership is of first importance in the progress of the profession, these messages have been prepared.

Of all the activities carried on by the American Dental Association, none is more important and none plays a larger part in the progress of the profession than research. "Research," we are informed, "is the mainspring in the chronometer of science, the register of a profession's achievement and standing. With it, there is life and growth and effectiveness and enthusiasm in those who devote themselves to the high calling of a profession." "Research," in a word, "is war on the autocracy of ignorance."

It was with this in mind that the American Dental Association set up the Research Commission, which, since April 1928, has cooperated with the Bureau of Standards in Washington in examining and testing materials used by the dentist in his daily work. These include such items as cements, alloys, metals used in operative and prosthetic dentistry, inlay waxes and impression compounds. The result of these investigations is published from time to time in THE JOURNAL. A complete list of certified materials as of July 1, 1939 (numbering more than a hundred) will be found in THE JOURNAL for July 1939, page 1197. If you have not been guided in your choice of materials by the findings of these research projects, you are failing to avail yourself of one of the Association's most important efforts to be of service to you.

This work by the Research Commission, which was carried on last year at an expense to the American Dental Association of $16,321.53,

makes it possible for the dentist, anywhere, to use materials that have been tested and found to be reliable. Few realize how much this adds to the value of the service rendered, and how important it is that this be done if the public is to be properly served.

In addition to these investigations, which are of incalculable value to both the profession and the public, the Commission is engaged in compiling the findings of dental research as carried on throughout the world. The first step in this direction has been the publication, in abstract form, of present-day knowledge regarding the etiology and control of dental caries. This book, entitled "Dental Caries," so ably edited by William J. Gies, is one of the outstanding contributions to this important subject. No one interested in the topic can afford to be without it. The cost is $1.00.

Another step projected by the Commission is the establishment, at one of the federal institutions in Washington, of a fellowship for the intensive and systematic investigation of caries and periodontoclasia, those twin scourges of the human race. This proposed fellowship will be operated and maintained similarly to the A. D. A. Fellowship at the National Bureau of Standards.

The Research Commission is made up of twenty-five members, not including three ex-officio members. It represents one of the standing committees of the A. D. A. and the members are elected by the House of Delegates. P. C. Lowery, of Detroit, is chairman and Daniel F. Lynch, of Washington, secretary. To these officers and members of the Commission, all of whom serve without remuneration and often at great personal sacrifice, the profession owes a debt of gratitude.

In addition, there is the small group located in the Bureau of Standards which, year in and year out, is engaged in studying and testing these dental materials. The work they are doing is of such importance to the progress of dentistry that you who make up the membership of the A. D. A. should know who they are. Here are their names: George C. Paffenbarger, D.D.S., F.A.C.D.; William T. Sweeney, A.B. (physics); John R. Beall, B.S. (mechanical engineering), and Harold John Caul, B.S. (chemical engineering). These are the Research Associates of the A. D. A. In addition, there are two members of the staff of the National Bureau of Standards on Dental Materials; namely, Wilmer Souder, Ph.D. (physics) and Irl C. Schoonover, Ph.D. (chemistry). To these also, the profession owes a debt of gratitude. Without such work as they are engaged in doing, there could be little progress in dentistry. To them and to all others having to do with the work of the Research Commission, the dental profession should extend congratulations and thanks for the excellent work that they are doing. "They also serve."

Under the head of research, there should be included the survey of the dental needs of the adult population which the Economics

Committee will undertake during the last week of May. This is a matter of the utmost importance. The success of the survey will depend on the cooperation of the members of the Association. Cards asking for the needed information will be sent during May to about 8,000 dentists in all parts of the country. This is being done in an effort to solve the problem of the dental needs of the adult population and to determine what is necessary to meet these needs. It is a lack of information that has made the solution of the problem difficult. Members of the Association can be of great assistance by filling in the cards as soon as they are received. Further information will be found on page 806.

Arthur A. Merrill

# BUREAU OF PUBLIC RELATIONS

## THE GREAT PUBLICITY MYTH AND ITS MORAL

By I. Franklin Miller, M.A., D.D.S., Pittsburgh, Pa.

THE Great Publicity Myth is the belief that if enough money were judiciously spent in publicizing dentistry, a dental millennium would arrive. After a year or two of persistent and skilful propaganda throughout the country, via the radio, the popular magazines and the newspapers, dental offices would be thronged by patients and appointment books would be filled for weeks to come. The value of dental health service would be universally appreciated. The comforts and conveniences that now have first call on purchasing power would sink to the levels of second choice. In brief, the public at large would be made to *want* dentistry.

Needless to say, this delusion besets the minds of our brethren in the dental trade more than it does the minds of members of our profession. Nevertheless, many dentists do cherish a secret, often an avowed, belief that some such miracle could be wrought. They frequently betray the thought that our present modest, but carefully planned programs for the education of the laity are but tentative steps toward a gigantic, nation-wide program of informative publicity, to be undertaken when the necessary funds are available. I have no idea how many dentists are thinking along these lines, but I believe that there is a large enough number to make the subject worth discussion, though they are unaware of all its implications.

The Great Publicity Myth, as I prefer to term it, usually evolves through some such mental process as the following:

Look at what advertising did for the orange growers of California! See what the Bell Telephone Company accomplished for long distance service by advertising! Do you suppose that all of us would be clean shaven

if it were not for the advertising of the manufacturers of safety razors and shaving cream? Would one person out of six own an automobile if it had not been for the impetus given by the advertising of the automobile industry?

And so on, and so on, example is piled on example, particularly if an advertising man has had a chance to lend a hand, regardless of the absence of any analogy between the products or the services that are cited and the services required of the dentist; until the fallacious conclusion becomes a fixed idea. If publicity can change old habits, if it can create new ones, in so many different fields of human behavior, it must be capable of making millions develop the habit of going to the dentist who now go seldom, if at all.

As a rule, this myth can be scotched, but not killed, by a discussion of expense. With no more than a superficial acquaintance with the space rates of the popular magazines and the metropolitan newspapers, also the time rates of the great broadcasting stations, it is easy to show that results comparable to the classic triumphs of advertising would cost not hundreds of thousands of dollars, but millions of dollars; and, although such discussions of expense always reduce the proponents of the idea to silence and discouragement, the condition is only temporary. The Great Publicity Myth invariably bobs up again. Cost is not the most cogent reason that the idea is a mere myth. However improbable it may sound, it is not impossible that several million dollars, perhaps a total of five millions or more, could be raised for a publicity campaign for dentistry for a period of two or three years.

All of us realize that the dental industry might provide such a sum of money, if—and of course it is a big if—it were convinced that a nation-wide campaign would result in a sufficiently large increase in the number of patients seeking dental service. We need not stop to speculate as to what would constitute a sufficiently large increase. We may leave this to the accountants, the statisticians. For the sake of having a definite, if hypothetical, figure for the present discussion, let us assume that the present number of patients could be trebled in two years, including the revisits of old procrastinators as well as the visits of new patients.

If dental practice were trebled in two or three years, it is reasonable to assume that there would be a like increase in the sales of the dental trade to the dental profession. If, as we are told, one million dentures are now constructed each year, it is not improbable that at least three million dentures would be made annually when publicity was beginning to have its full effect. This means at least three times the present quantity of teeth and denture materials that are now being sold in the same period of time, with comparable increases in the sales of filling materials, golds, ferrous alloys, impression materials, burs, stones, instruments, equipment and all other essentials for the operating room as well as necessities for the laboratory. May it not be assumed that the dental trade would regard the expenditure of even five million dollars upon national publicity for dentistry as a sound investment in prosperity—*provided* such an increase in dental practice could thereby be brought about?

I do not say that this consummation is probable, but who can declare it to be impossible? And as long as it cannot be said to be impossible, the factor of *cost* is not the prime argument for calling the idea of national publicity a myth. If the idea is to be scouted and forever forgotten, which it should be, there must be a better reason, one about which there can be no argument.

It may be urged that even if the dental trade could be induced to finance such a campaign, it would miss fire; that the cleverest propaganda ever devised

could never so overcome the popular dread of dental operations, the popular aversion for dentists, as dentists, and for dentistry, as to treble dental practice in a few years. It could be emphasized that people have no actual antipathy for orange juice, automobiles, clean shaven faces, long distance telephone calls or any other of the various luxuries, comforts and conveniences that have been popularized by advertising, but that the problem of changing a general aversion into a general "consumer acceptance"—to use one of the precise expressions of advertising thought—has rarely, if ever, confronted the billion dollar business of commercial publicity. All of this may be granted, for the sake of argument—and the argument is a good one—but no facts can be adduced to show that the thing could not possibly be done. What we need are considerations, not of possibility, but of reality, about which no questions can be raised.

Such considerations become apparent as soon as we realize clearly the lines along which this national publicity would have to proceed, in order to be effectual, and the truth about dentistry as dentistry is actually practiced. The indubitable conclusion that will then be reached is that such publicity for dentistry would prove a dangerous boomerang for the dental profession, that its ultimate damage would be proportionate to the initial success of its impact upon the national consciousness.

Let us begin with the conditions that would necessarily govern the suggested publicity. Any national advertising campaign would fail if it were planned and directed by amateurs. Now, dentists may be skilled in the technic of dentistry, and in the art of overcoming the prejudices, the fears of individual patients. Dental manufacturers may be masters of dental technology. Dental supply men and salesmen may be virtuosos when it comes to selling any dentist a bill of goods. Yet who dares say, by even the wildest stretch of the imagination, that either dentists or dental men are masters of the very special art of controlling the mass reactions of millions of our heterogeneous citizenry, through their eyes and ears? So, for this campaign to be successful, it would have to be in the hands of people who were not amateurs at their own game. A large and highly experienced advertising agency would have to be employed, aided by a thoroughly competent and reliable public relations counsellor, whose particular duty would be to secure the widest possible circulation for favorable dental "news" stories in the metropolitan and in the rural press. Aside from matters of basic policy, the conduct of the campaign would have to be relinquished to a general staff of experts.

As to one question of fundamental policy, our profession would be well supported. There would be no particular allusions in the advertising copy to the materials or the mechanisms used in dentistry. The dental trade would help us to take care of that. It is true that many hired advertising copy writers would welcome such an approach. It would provide them with dramatic illustrations of the "progress of dental science." They know that mulitudes who have passed the age of adolescence are very curious about novel substances or mechanisms, especially when these have some application to the organs or the functions of the body. However, the dental trade would positively concur with our profession on this point, but for different, though none the less cogent, reasons. Any too specific references to materials or to apparatus might give some manufacturers a special advantage over others. Now, according to our hypothesis, this campaign would largely, if not wholly, be financed by the dental trade for the benefit of the whole dental industry, not for particular members thereof in preference to others.

This would apply also to stories about

operative procedure, restorative devices and prosthetic appliances. Anything but the most general references to "fillings, inlays, bridgework, platework," any detailed descriptions of different types of such means of restoration and remedy, would be strictly taboo. Such specific references would inevitably enable some manufacturers to slide into a privileged position. The point that I am trying to make may not be obvious to many readers, but on careful perusal of the trade advertisements in our professional journals, and with a little thought, they will see what I am driving at.

So, the campaign would necessarily devolve into what one might term the Apotheosis of the Dentist. Educational stories would be sandwiched between the slogans, the headlines, the pictures of dentists. On broadcasting programs, "educational" talks would be welcome, or unwelcome, interruptions of the swing program of general joyousness. In the advertising pictures, The Dentist would sometimes be elderly, at other times young or middle-aged, but always good looking, intelligent, kind, and just exuding competence—and he would never be without a pretty nurse, looking at the public from underneath her long eyelashes. This kind of thing is meat for advertising agencies. They are doing it all the time. The real problem would arise over the slogans and headlines.

It is an important problem, because slogans and headlines are the spear points of every successful attack upon the mass mind. They must be concise; they must be so keenly pointed as to arrest the attention. They must be pertinent to the advertising story. Their meaning must be obvious to minds of the lowest I.Q. In brief, if they have to be explained, they are no good, unless they happen to be irresistible exciters of curiosity.

Let us look at this problem for a moment. It touches some of our fundamental difficulties. The solution would be the answer in a few words, not more than eight Anglo-Saxon words of two or three syllables, to such questions as the following: *What* is a dentist? *What* purpose does he fulfil? *Why* do dentists exist?

Of course, every dentist will be ready with indignant answers, but not satisfactory answers in eight Anglo-Saxon words of no more than three syllables. I stress the necessity of Anglo-Saxon words because the latinized terms of our professional sophistication strike no sparks of consciousness in the minds of the millions.

The medical profession has no such problem. Who, in the possession of his senses, can imagine the necessity of a national publicity campaign for "medical health service"—except those fanatics who bother people about "preventive medicine"? Folks go to their "doctors" anyway, as often as symptoms become uncomfortable, if not painful; while their mouths are going to ruin.

Yet the answer of the general public to the question *What* is a dentist? would be quite simple, unless the slogans and headlines produced instantly an entirely different line of thought. Apart from being a mere allayer of toothache, the dentist is no more than a vendor of certain commodities. He is a pedlar of fillings, inlays, crowns, bridgework, platework. That is what the dentist is in the minds of the laity. Whether we like it or not, that is where we still stand.

A national publicity campaign, if it were successful, would bring millions of people to dental offices, millions of shopping patients, expecting fillings, inlays, crowns, bridges or plates. They would not be the people who have always had the means and the inclination to go to their dentists regularly, whose mouths are in fairly good condition. They would be the populace whose mouths have been ravaged by caries and pyorrhea, who have had extractions merely to stop toothache, whose teeth have drifted; cases

in which the occlusal relationship has been lost—if it ever existed—people in dire need of complete mouth reconstruction, or full dentures *properly made,* but whose economic circumstances have compelled them either to forego dental service entirely or, at best, have allowed them nothing but patchwork dentistry, repairs of temporary value, the kind of dental treatment that does not retard the ruin of their mouths, but oftener brings it on more rapidly.

"So what?" a realist might observe. "Do you intend to tell us that the dental work that the millions can afford does more damage than Nature herself inflicts for procrastination and neglect? If not, you must admit that some good would come of bringing more millions into the kind and careful hands of the dentist. Many would be benefited, even if many other mouths were ruined in a few years. After all, the laity, that is the poorer laity, does not expect very much from the dentist, chiefly because very few dentists, for good reasons, bad reasons or no reasons at all, ever tell the laity what *real* dental care is, and so the situation would be just the same as it is now, but improved for the profession and the trade in that an era of prosperity would ensue. Our incomes would be increased and larger funds would be available for research, for postgraduate education and for progress."

So might speak the realist, but, in doing so, he would give the whole Publicity Myth away. He would betray the dilemma, about which there can be no argument; for, and keep this in mind, *the situation would not be the same as the one that exists today.* Whereas the millions may not expect very much from the dentist now, because they do not know what real dental service is like, they would learn that lesson from a national advertising campaign. That campaign could not impress them at all unless it raised the dentist to a very high plane, no higher, perhaps, than he deserves, but much higher than the masses suppose him, at present, to merit.

It is this that would cause the bad reaction. The economic circumstances of the public at large make it impossible for them to receive the kind of service that any effectual publicity campaign would necessarily lead them to expect, while it would educate them to clearly perceive the disparity between what they were told and what they received. That is why this idea is a myth, a foolish myth, a dangerous myth.

The moral of this long discussion is well indicated by something related to me recently by a dental salesman. He used to be a dental mechanic and therefore knows quite a little about dentists. He is middle-aged, but has never overcome a certain naiveté, the weakness of being often surprised. A dentist, a friend and customer of this salesman, an elderly man, but not unsuccessful, had just extracted a third molar for a rather shabby, poor man. The patient was profoundly grateful. The nerve of that molar had been exposed and the patient had gone through torments all night long. He said, "Doc, I've been out of work for a long time and I have only two dollars." The dentist smiled kindly, "Don't worry about that," he said. "Keep your money now and pay me when you can. I am only too glad to have been able to relieve your suffering."

After the man had gone, the dentist produced a plaster cast. "Here is a tough case, Bill!" he exclaimed. "I'll swear I don't know what to do with it!" According to Bill, the cast showed little more than the occlusal surfaces of the remaining posterior teeth, teeth that had drifted into the most inconceivable positions, the anterior teeth overlapping and protruding at sharp angles. "What about the lower?" Bill asked. "Oh!" the dentist replied, "I did not get an impression of the lower, and it is in bad shape too." In order to hide his em-

barrassment, Bill feebly murmured something about roentgenograms. The dentist replied instantly, "Oh, no! This patient could not afford a full mouth x-ray examination, and all that. I tell you, it is a tough case!"

Let no dentist say that this incident is not typical. If any one does, my retort is that he is practicing in a nice ivory tower. He does not now know what is going on. In Bill's opinion, that dentist should have accepted the two dollars that the former patient had expected to pay and was prepared to pay gladly for his relief from pain, but the latter patient should have received a complete diagnosis, with all that that implies, without charge if necessary. In fact, it is Bill's radical belief that no case should be approached without a complete diagnosis, and a thorough explanation to the patient of the problem involved; that the cost of diagnosis should be treated as a dental office overhead item, like rent, for example, not to be charged to the individual patient at so much per examination, but included in all fees, for all patients, for all services rendered.

We do not have to be guided by the opinions of dental salesmen or dental mechanics. We need not stop to consider the real involvements of Bill's revolutionary idea. Nevertheless, we must bear in mind that public education begins in the dental office, in the mind of the dentist, that as "doctors" we are not merely practitioners of an art, but are also teachers of its value. Is not our title "doctor" derived from a latin word that means teacher? Complete diagnosis is not merely a procedure for our own information, but, with all the necessary "exhibits," if we can call them that, it is the means of demonstrating to the individual patients what the proper corrective treatment really means. When they cannot afford that treatment, but must accept something less, they can be made to understand that the services they paid for were not true dental service, but merely temporary, merely reparatory, and ultimately destructive, unless or until they are in a position to pay for more complete dental service.

If our profession were to concentrate more upon diagnosis and less upon technic and novel materials, the public would slowly, but surely, arrive at a better understanding of what a dentist really is, what he is prepared to do and why he exists. The process would be slow, but it would be sure—and it would have no adverse reactions.

An eminent dentist from Berlin once made this observation to me: "Our technical achievements are much inferior to yours because ours is a relatively poorer country. However, I have observed this difference between my colleagues and yours. An American dentist always seems to ask "How is it done?" A German dentist wants to know why it is done.

In the years to come, we must have the answers to *"Why?"* for our patients, if we are to make further progress.

412 Medical Arts Building.

# THE ROCKY MOUNTAIN MID-WINTER MEETING

By CHARLES G. GROVER,* D.D.S., Denver, Colo.

FOR thirty-three years, it has been the privilege of the Denver Dental Association to act as host to several hundred dentists at its annual midwinter meeting. This year, several entirely new features were introduced which met with the approval of the majority of the members and were greatly appreciated by the general public.

Realizing that there was a need for public health education of the laity and that dentistry had had little or no part in this educational work, a scientific and health exhibit feature, to be open to the public, was planned.

Orthodontic exhibit, Rocky Mountain Mid-Winter Meeting, January 1940.

The first step was an official act of Gov. Ralph L. Carr, proclaiming the week of January 7 to 13 Dental Health Week.

EXECUTIVE ORDER

PROCLAMATION

WHEREAS, dentistry is recognized as an important service to the public health, and in order that the present high standards of that service be maintained and be made available to all of the people of this state,

It is fitting that a week be set aside to impress upon the public mind the health benefits to be derived from this service;

Now, therefore, I, Ralph L. Carr, Governor of the State of Colorado, do hereby proclaim the week of January 7 to 13, 1940, Dental Health Week.

I urge the citizens of Colorado to cooperate in giving special thought and study to their dental health.

In witness whereof, I hereunto have set my hand and the Executive Seal of the State of Colorado, this fifteenth day of December 1939 A.D.

Signed: RALPH L. CARR,
Governor, State of Colorado.

Owing to the excellent cooperation of the governor, this proclamation was given newspaper and radio publicity for two weeks before the meeting.

*Dental member of the Colorado State Board of Health.

The exhibits were so planned that no persons should be identified with them. Each exhibit was given a number, and the title of the exhibit appeared on a sign above the exhibit. The exhibitor was given credit for his work in the official program, which was available only to the registered members of the profession.

All exhibits were sponsored by the Colorado State Board of Health as a public health educational feature. In this manner, radio time could be demanded because time must be given by all broadcasting stations for public educational work. This arrangement also aided in securing newspaper publicity for the meeting.

As the full benefits that would be derived from the exhibit by all men in the profession were not recognized, and owing to the skepticism of a few who did not believe that such an exhibit could be conducted for the public in an ethical manner, the full benefits possible from early publicity were lost. However, as soon as the exhibits were opened, most of the skepticism vanished and there was a demand that the exhibits be given the utmost in publicity. Owing to this demand, the exhibits remained open one night longer than had been planned.

Even with this lack of early publicity, approximately 5,000 of the general public and about 300 dentists had the privilege of viewing the exhibits.

One highschool cooperated to the extent of allowing one hour's credit in science for each pupil attending. There were 600 pupils in attendance from this school and their remarks indicated a general interest in the educational material that was shown.

Members of the medical profession whose work was closely allied with dentistry were invited to participate, and many excellent exhibits were shown by them. Each department of the state board of health presented exhibits.

In all, there were forty-nine scientific

Oral and facial deformity exhibit, Rocky Mountain Mid-Winter Meeting, January 1940.

exhibits, occupying 485 linear feet of space and 8 feet in height. The subjects covered were: occupational therapy; plastic surgery of the nose; oral and facial deformities; dental roentgenograms, with case histories and interpretations; permeability of synthetic porcelain fillings; toothbrushes and stimulators; tic douloureux; orthodontia; dental journalism; pathologic fractures of the mandible; variations in congenital bone formations and their association with alveolar conditions; periodontoclasia; importance of phonetics in full dentures; surgical procedure and treatment of oral pathologic lesions; treatment of hemorrhage with snake venom; paraffin infiltrated gross specimens; fractures of facial bones and their treatment; natural color photographs of lesions of mouth and face; medical and dental illustrations; pathologic mandibles; bronchoscopy and esophagoscopy; proper roentgen survey of the sinuses and mandible; dermatologic diseases of the mouth; roentgenograms and slides; intra-oral and extra-oral vital statistics; spot maps of selected diseases; information about syphilis, facioplastic corrections by orthodontic treatment; unusual exodontia cases; crippled children's service in Colorado under the Social Security Act; dental health educational exhibit; impure and improperly labeled foods and drugs; prenatal care and the care of premature infants; sanitary engineering, and the bacteriologic and serologic laboratory.

In addition to the scientific exhibits, the Dairy Council, the Women's Field Army for the Control of Cancer, the dental hygienists and the dental assistants presented exhibits.

As this was a first attempt at public education by means of collective exhibits, many lessons were learned by those responsible for the exhibit. Most of them were matters of detail and can be corrected easily.

From all surveys that have been made, it appears that only a small percentage of the population is not suffering from dental disease. Few mouths could be examined and found free of caries. A high percentage also suffer from pyorrhea. There is hardly any one who is not in need of prophylaxis—to say nothing of restorative and corrective procedures.

There is more dental treatment needed today than it would be possible for all of the dentists to render. Why, then, is it that the dentist is not busy serving his community and improving the public health?

The only plausible answer, it seems, is a lack of education of the public. When all classes can be made to realize that dental health affects the general health, that an infected tooth is just as dangerous as an inflamed appendix or tonsil, the public will demand dental health and will not be afraid of treatment. They will not be ignorant of the need, and will be enlightened as to the benefits.

Such an exhibit as was given by the Denver Dental Association meets this need of public education, reaching all classes of people in an ethical manner. It shows the close connection between dental and general systemic disease and makes the public realize more fully the importance of dental treatment.

It is hoped that other societies will find it possible to devote a part of their programs to public education. We have just celebrated 100 years of dental education of the dentist. "The first hundred years are the hardest." Let us devote the next 100 years not only to improving our own knowledge, but also to giving the public the benefit of that knowledge in health and happiness.

# COUNCIL ON DENTAL THERAPEUTICS

## PRESCRIBING SUGGESTIONS

THE rational use of drugs and chemicals is an essential part of dental practice. Over a period of years, the Council has issued numerous reports designed to aid the dentist in the selection of drugs and chemicals of demonstrated usefulness. Many of these are National Formulary and U. S. Pharmacopeial substances, listed and adequately described in Accepted Dental Remedies 1939. In order that the dental profession may use acceptable and official products and to the best advantage, the following formulas have been suggested.

The Council appreciates the cooperation of George C. Schicks, assistant dean of Rutgers University, chairman of the Committee on Dental Pharmacy of the American Pharmaceutical Association, in the preparation of the formulas.

### SERIES IV

DENTAL ABRASIVE PASTE

a)

| ℞ | Metric Approx. | Apoth. Equivalents |
|---|---|---|
| Pulv. Pumice N.F. | 24.0 gm. | ʒ vi |
| Glycerite Starch | 36.0 gm. | ʒ ix |
| Methyl Salicylate | 0.5 cc. | m. viii |
| Liq. Amaranth | 1.0 cc. | m. xv |

Office use. Agreeable taste and color. Disguises color of blood in prophylaxis Stays under brush—does not fly from brush or teeth. Quantity of pumice may be increased or decreased as desired.

b)

| ℞ | Metric Approx. | Apoth. Equivalents |
|---|---|---|
| Pulv. Pumicis | 1.3 gm. | gr. xx |
| *Pulv. Amyli | 0.24 gm. | gr. iv |
| Methylis Salicylatis | 0.06 cc. | m. i |
| Carmini | 0.005 gm. | gr. 1/12 |

Make 12 such capsules.

Office use. Contents of one or more capsules as an abrasive.

For the particular patient. Dentist's use only. Add a few drops of glycerin or water to powder after taking from capsule.

*Powdered starch.

DENTURE ADHESIVE

c)

| ℞ | Metric Approx. | Apoth. Equivalents |
|---|---|---|
| Pulv. Tragancanth | 22.5 gm. | ʒ vi |
| Pulv. Karaya Gum | 7.5 gm. | ʒ ii |
| Oil Sassafras | 0.5 cc. | m. viii |

Sig: Sprinkle sparingly on denture before placing in mouth.

Note: Acacia may replace tragacanth if desired.

DENTURE CLEANER

d)

| ℞ | Metric Approx. | Apoth. Equivalents |
|---|---|---|
| Trisodii Phosphatis | 120.0 gm. | ʒ iv |
| Olei Cinnamomi | 0.3 cc. | m. v |
| Liquor Amaranthi | 2.1 cc. | ʒ ss |

M.

Sig: Dissolve scant ¼ teaspoonful in full glass water and use with brush. Do not leave denture in solution overnight.

Note: Cellulose acetate type denture is decomposed by alkaline substances. Formaldehyde and phenol formaldehyde type withstand most chemical substances.

PULP DEVITALIZING PASTE

e)

| ℞ | Metric Approx. | Apoth. Equivalents |
|---|---|---|
| Paraformaldehyde | 1.0 gm. | gr. xv |
| Procaine Base | 0.3 gm. | gr. v |
| Powdered Asbestos | 0.5 gm. | gr. viii |
| Petrolatum | 1.25 gm. | gr. xx |
| Carmine | 0.015 gm. | gr. ¼ |

TEMPORARY CEMENTS

f)

℞

Zinc Oxide A.D.R.† and Eugenol, a convenient quantity to make a paste.

†Zinc Oxide as described in Accepted Dental Remedies.

g)

℞

| | |
|---|---|
| Zinc Oxide | 10.0 gm. |
| Thymol | 5.0 gm. |

M.

Melt thymol on a water bath in a porcelain evaporating dish. Add the zinc oxide and rub to a smooth paste in a thin layer on the sides of the evaporating dish and cool. Remove with spatula.

Keep in well closed bottle.

For pulp capping.

h)

| ℞ | Metric Approx. | Apoth. Equivalents |
|---|---|---|
| Powder | | |
| Zinc Oxide A.D.R. | 69.0 gm. | ʒiiʒi gr. xlv |
| ‡White Rosin | 29.3 gm. | ʒvii gr. xxxii |
| Zinc Stearate Powder | 1.0 gm. | gr. xv |
| §Zinc Acetate | 0.7 gm. | gr. xi |
| Liquid | | |
| Eugenol | 85.0 cc. | ʒiiʒvii |
| Olive Oil | 15.0 cc. | ʒiv |

‡The presence of rosin is said to improve the physical properties of the finished cement.

§$Zn(CH_3CO_2)_2.2H_2O$. Setting accelerator. The proportion of this ingredient may be varied to assure the desired setting rate.

To prepare the powder, grind the rosin with successive portions of zinc oxide until all of it passes a 100-mesh screen. Grind the zinc acetate to pass a 200-mesh screen and mix all the ingredients thoroughly.

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## FEDERAL TRADE COMMISSION STIPULATION ON CE-KELP

THE Federal Trade Commission has accepted from Melvin E. Page, trading as the Dental Research Company, Muskegon, Mich., a stipulation in which he agrees to discontinue misleading representations in the sale of a kelp preparation advertised as "Ce-Kelp, the Gift of Nature to Man" and "A Vegetable Sea Food Rich in Minerals."

Among representations which the re-

spondent agrees to discontinue are that his product is "rich in minerals"; that it prevents or corrects what physicians call the deficiency diseases, and that heart trouble, tuberculosis, anemia, high and low blood pressure, hardening of the arteries, rheumatism, neuritis, arthritis, kidney and bladder trouble, frequent colds, nervousness, constipation, acidosis, pyorrhea, overweight and underweight, cataract and cancer are recognized or properly classified as deficiency diseases.

The respondent also stipulated that he will cease representing that the main cause of deficiency diseases is lack of mineral elements in ductless glands, or that his commodity or any other kelp product is "literally packed" with such essential elements.

The respondent stipulates that he will desist from designating himself as "Dr." or "Doctor" unless it be clearly disclosed that he is a doctor of dentistry and not of medicine.

The stipulation points out that, according to reliable medical authority, the respondent's various claims and inferences are contrary to the weight of scientific evidence and are based upon premises that cannot be substantiated. (Stipulation 2704)

## ABSTRACT OF FEDERAL TRADE COMMISSION STIPULATION ON ZONITE PRODUCTS

ZONITE PRODUCTS CORPORATION, 405 Lexington Ave., New York, N. Y., has entered into a stipulation with the Federal Trade Commission to cease misleading representations in the sale of preparations designated "Zonite Ointment," "Zonite Liquid" and "Vaginal Suppositories (Zonitors)."

Other representations which the respondent agrees to discontinue are that "Zonite Liquid" has a soothing action on the membranes or may always be used without risk, or that it can never injure delicate tissues; that its use assures freedom from grippe, colds, coughs and other diseases of the respiratory system; that it is effective in combating the cause of pyorrhea; that it will control all dandruff or itchy scalp skin and end dandruff or itchy scalp; that it will kill onion breath permanently, and that the respondent's products are the only antiseptics which are non-poisonous under similar conditions of use. (Stipulation 02531)

## FEDERAL TRADE COMMISSION STIPULATION ON ACQUIN

ACQUIN PHARMACAL COMPANY, also trading as Acquin Products Company, agrees to cease making representations which convey the impression that its preparation "Acquin" is competent or effective in treating headaches, simple neuralgia, colds, sore throat or other ailment, or is efficacious for any purpose other than as a means of temporary relief of minor pains or the mild discomforts that are incident to them. (Stipulation 2711)

# ACCEPTED DENTAL REMEDIES

The Council on Dental Therapeutics of the American Dental Association announces the inclusion of the following articles in the list of Accepted Dental Remedies.

## ROSIN*

***Hydrogenated Wood Rosin:*** Prepared by catalytic reduction of wood rosin.

PROPERTIES: The material is clear and almost odorless. It has greater freedom from taste than rosin. Its solubility and incompatibility are approximately the same as those of rosin.
Specific gravity at 25°C.: 1.040 to 1.050.
Ash content: Less than 0.02 per cent.
Reaction: Acid to litmus in alcoholic solution.
Acid value: Not less than 155 (U.S.P. method for rosin).
Melting point by drop method: Approximately 74°C.

ACTIONS AND USES: Same as for rosin (see A.D.R. 1939, p. 194). It is claimed that the product is clearer than rosin and not so susceptible to oxidation.

***Hydrogenated Rosin—Staybelite:*** A brand of hydrogenated rosin.

Manufactured by Hercules Powder Co., Wilmington, Del. U. S. patent No. 2,113,808. U. S. Trademark No. 329,898.

## Anesthetics—Local†

***Procaine 2% with Epinephrine 1:50,000-Neo-Quest Brand:*** Each cubic centimeter is said to contain procaine hydrochloride, 0.002 gm.; epinephrine (base), 0.00002 gm.; potassium sulfate, 0.0033 gm.; sodium chloride, 0.0066 gm.; sodium thiosulfate, 0.0013 gm.; sodium bisulfite, 0.00067 gm.; chlorobutanol (chloroform derivative), 0.005 gm., and distilled water.

Manufactured by Neo-Quest Chemical Co., Inc., Long Island City, N. Y.

*Procaine 2% with Epinephrine 1:50,000-Neo-Quest Brand in Cartridges.*

***Procaine 2% with Epinephrine 1:25,000-Neo-Quest Brand:*** Each cubic centimeter is said to contain procaine hydrochloride, 0.02 gm.; epinephrine (base), 0.00004 gm.; potassium sulfate, 0.0033 gm.; sodium chloride, 0.0066 gm.; sodium thiosulfate, 0.0013 gm.; sodium bisulfite, 0.00067 gm.; chlorobutanol (chloroform derivative), 0.005 gm., and distilled water.

Manufactured by Neo-Quest Chemical Co., Inc., Long Island City, N. Y.

*Procaine 2% with Epinephrine 1:25,000-Neo-Quest Brand in* Cartridges.

## DENTIFRICES‡

***Vandever's Tooth Paste.*** Composition: See Sheffield Tooth Paste (A.D.R. 1939, p. 117).

Manufactured by Sheffield Company, New London, Conn. Distributed by Vandever Dry Goods Co., Inc., Tulsa, Okla.

Admission of an article to the list of Accepted Dental Remedies does not imply a recommendation. Information regarding the rules and work of the Council will be sent on request.

HAROLD L. HANSEN, *Secretary.*

*A.D.R. 1939, p. 194.
†A.D.R. 1939, p. 38.
‡A.D.R. 1939, p. 108.

# RESEARCH COMMISSION OF THE AMERICAN DENTAL ASSOCIATION

## LISTS OF CERTIFIED DENTAL MATERIALS

(As of March 15, 1940)

THE A.D.A. Research Commission, in cooperation with the National Bureau of Standards, has developed specifications for the following materials: amalgam, inlay investment, impression compound, inlay casting wax, inlay casting gold alloy, mercury, wrought gold wire, zinc phosphate cement and silicate cement.

Samples of the foregoing materials which were certified to the Research Commission by the various manufacturers as complying with the A.D.A. specifications were procured on the retail market by the Research Commission and were tested by the A.D.A. Research Associates at the National Bureau of Standards. The following certified materials were found to comply with the A.D.A. Specifications. Certified materials which did not comply with specifications are omitted from the lists.

Materials listed below are constantly being tested. Therefore, the lists are subject to revision from time to time. The revised lists will be published in the JOURNAL. These lists are your buyers' guide.

CERTIFIED AMALGAM ALLOYS (A.D.A. SPECIFICATION NO. 1.)

| Alloy | Manufacturer or Distributor |
|---|---|
| Accurate Metalloy (filings) | The L. D. Caulk Co. |
| Ackerman (filings) | Ackerman Dental Mfg. Co. |
| Argentum ("A" cut) | Hammond Dental Mfg. Co. |
| Argentum (fine cut) | |
| Argentum (medium cut) | |
| Argentum (shavings) | |
| Aristaloy | Baker & Co., Inc. |
| Banner (filings) | Goldsmith Bros. S. & R. Co. |
| Blue Diamond (filings) | Reliance Dental Mfg. Co. |
| Brewster Medium (shavings); Quick (filings); Quick (shavings) | E. R. S. Brewster |
| Capeako (filings) | Precious Metals Refining Works |
| Certified | Lee S. Smith & Son Mfg. Co. |
| Coe | Coe Laboratories, Inc. |
| Cresilver | Crescent Dental Mfg. Co. |
| Dee (filings) | Thomas J. Dee & Co. |
| Diamond Edge | Young-Baker & Co. |
| Excel | Daniels Dental Alloy Co. |
| Fleck's | Mizzy, Inc. |
| Garfield's | Garfield Smelting and Refining Co. |
| Gold Bond | Jefferson Laboratories |
| Minimax (filings) 173, 177, 178, 183, (shavings) 177, 178 | The Minimax Co. |
| Minimax White Gold & Platinum | |
| Mission No. 5 | Henry F. Bruce Co. |
| Mission No. 5 ("A" cut) | |
| Mission No. 6 | |
| Modeloy (Quick Setting) (filings) | Crescent Dental Mfg. Co. |
| Moyco Higrade | The J. Bird Moyer Co. |

| | |
|---|---|
| Mynol Improved | Mynol Chemical Co. |
| New Deal | Miller Dental Co. |
| Ney-Aloy | The J. M. Ney Co. |
| Ney's No. 125 | The J. M. Ney Co. |
| Odontographic "Improved" (filings) | Odontographic Mfg. Co. |
| Pearlol | Wildberg Bros. S. & R. Co. |
| Preferred C | Precious Metals Refining Works |
| Preferred D | Precious Metals Refining Works |
| Research Oralloy | Precious Metals Research Works, Inc. |
| Royal Special—First Setting | Garhart Dental Specialty Co. |
| Royal Super—First Setting | Garhart Dental Specialty Co. |
| Silver Crown | General Refineries, Inc. |
| Silver Crown (Medium) | General Refineries, Inc. |
| Silverloy (filings), Silverloy (shavings) | Crescent Dental Mfg. Co. |
| Speyer | Speyer Smelting & Refining Co. |
| S-C Medium (filings); S-C Quick (filings) | Stratford-Cookson Co. |
| S-R | Lee S. Smith and Son Mfg. Co. |
| True Dentalloy (filings) | The S. S. White Dental Mfg. Co. |
| True Dentalloy (cut "A") | The S. S. White Dental Mfg. Co. |
| Twentieth Century (Regular) | The L. D. Caulk Co. |
| Twentieth Century (Special) | The L. D. Caulk Co. |
| Uniform | Henry Nelms & Son |
| Vertex | Vertex Dental Products Co. |
| White Beauty | Lang Dental Mfg. Co. |

CERTIFIED INLAY CASTING INVESTMENTS (A.D.A. SPECIFICATION NO. 2.)

| Investment | Manufacturer or Distributor |
|---|---|
| Coecal Inlay | Coe Laboratories, Inc. |
| Coecal Universal | Coe Laboratories, Inc. |
| Kerr Cristobalite-Inlay | Detroit Dental Mfg. Co. |
| Ransom and Randolph Gray | The Ransom & Randolph Co. |
| Ransom and Randolph Green | The Ransom & Randolph Co. |
| S. S. White Inlay No. 20 | The S. S. White Dental Mfg. Co. |
| Security Improved Inlay | The Cleveland Dental Mfg. Co. |
| Steele's-Super | The Columbus Dental Mfg. Co. |

CERTIFIED IMPRESSION COMPOUNDS (A.D.A. SPECIFICATION NO. 3)

| Compound | Manufacturer or Distributor |
|---|---|
| Certified | Lee S. Smith & Son Mfg. Co. |
| Dresch | The Ransom and Randolph Co. |
| Kerr Black | Detroit Dental Mfg. Co. |
| Kerr Perfection | Detroit Dental Mfg. Co. |
| Kerr White | Detroit Dental Mfg. Co. |
| Mizzy—Low Heat | Mizzy, Inc. |
| Moyer | The J. Bird Moyer Co. |
| S. S. White—Black—Tray | The S. S. White Dental Mfg. Co. |

CERTIFIED INLAY CASTING WAXES (A.D.A. SPECIFICATION NO. 4.)

| Wax | Manufacturer or Distributor |
|---|---|
| Caulk-Blue | The L. D. Caulk Company |
| Kerr-Blue—Hard | Detroit Dental Mfg. Co. |
| Maves Green | The Heidbrink Co. |
| Security | The Cleveland Dental Mfg. Co. |
| Sterling | Baker & Co., Inc. |
| Taggart's Green | Mizzy, Inc. |

CERTIFIED INLAY CASTING GOLD ALLOYS (A.D.A. SPECIFICATION NO. 5.)

| Alloy | Type* | Manufacturer or Distributor |
|---|---|---|
| Aderer-A-Soft | A | Julius Aderer, Inc. |
| Aderer-B-Medium | B | Julius Aderer, Inc. |
| Aderer-C-Hard | C | Julius Aderer, Inc. |

| | | |
|---|---|---|
| Baker Inlay Soft | A | Baker & Co., Inc. |
| Baker Inlay Medium | B | |
| Baker Inlay Hard | C | |
| Bruce "A" | A | Henry F. Bruce Co. |
| Bruce "O" | B | |
| Bruce No. 5 | C | |
| Chilcast No. 1 | A | Vernon-Benshoff Co. |
| Chilcast No. 1-A | B | |
| Chilcast No. 2 | C | |
| Chilcast No. 2-A | B and C | |
| Crown Do-All-Casting | C | General Refineries, Inc. |
| Crown Inlay No. 2—Soft | A | |
| Crown Inlay No. 1—Hard | B | |
| Crown No. 9 | C | |
| Crown K | A | |
| Crown Knapp No. 2 | B | |
| Crown Knapp No. 3 | C | |
| Crown T | B | |
| Crown TT | C | |
| Deetwo Light | A | Thomas J. Dee & Co |
| Deetwo | B | |
| Deesix | C | |
| Dressel | C | Julius Aderer, Inc. |
| Goldsmith Inlay No. 1 | A | Goldsmith Bros. S. & R. Co. |
| Goldsmith Inlay No. 2-Medium | B | |
| Goldsmith Inlay No. 3-Hard | C | |
| Jelenko Alboro Inlay | C | J. F. Jelenko & Co., Inc. |
| Jelenko Durocast | C | |
| Jelenko Firmilay | C | |
| Jelenko Modulay | B | |
| Jelenko Platin-Cast | B | |
| Jelenko Special Inlay | A | |
| Lite Wite Inlay | C | Precious Metals Research Works, Inc. |
| Lite Wite Hard Inlay | C | |
| Mowrey B Inlay | B | W. E. Mowrey Co. |
| Mowrey-Special Inlay | C | |
| Mowrey T Gold | B | |
| Mowrey TT | C | |
| Nelms E | B | Henry Nelms & Son |
| Nelms F | A | |
| Nelms J | C | |
| Ney-Oro A | A | The J. M. Ney Co. |
| Ney-Oro AA | A | |
| Ney-Oro A-1 | B | |
| Ney-Oro A-10 | B | |
| Ney-Oro B | C | |
| Ney-Oro B-2 | C | |
| Research-A-Soft | A | Precious Metals Research Works, Inc. |
| Research-B-Medium | B | |
| Research-Inlay | C | |
| Research-Hard Cast No. 5 | C | |
| Spyco Hard | B | Spyco Smelting and Refining Co. |
| Spyco Soft | A | |
| Spyco No. 6 | C | |

| | | |
|---|---|---|
| S. S. White No. 1 | B | The S. S. White Dental Mfg. Co. |
| S. S. White No. 2 | A | |
| S. S. White No. 5 | B | |
| S. S. White No. 13 | C | |
| S. S. White No. 31 Metalba | B | |
| S. S. White No. 820 | B and C | |
| S. S. White No. 860-Hard | C | |
| S. S. White No. 940 | A | |
| Stern A-T (No. 2381) | C | I. Stern and Co. |
| Stern No. 2847 | C | |
| Stern No. 3290 | B | |
| Stern No. 3337 | C | |
| Stern No. 3375 | A | |
| Stern No. 3441 | C | |
| Stern No. 3465 | B and C | |
| Stern No. 6219 | B | |
| Stern H (No. 6485) | C | |
| Tinker No. 1 | B | Spyco Smelting and Refining Co. |
| Tinker No. 1H | C | |
| Tinker No. 2 | C | |
| Tinker Inlay | B | |
| Wildberg "A" | B | Wildberg Bros. S. & R. Co. |
| Wildberg "C" | C | |
| Williams-Klondiker | C | The Williams Gold Refining Co., Inc. |
| Williams No. 3 | A | |
| Williams-Pioneer | B | |
| Williams Special Inlay | B | |

*Relative hardness: A, soft; B, medium; C, hard

CERTIFIED DENTAL MERCURIES (A.D.A. SPECIFICATION NO. 6.)

| Mercury | Manufacturer or Distributor |
|---|---|
| Argentum | Hammond Dental Mfg. Co. |
| Chemically Pure | The S. S. White Dental Mfg. Co. |
| Crown | General Refineries, Inc. |
| Dee | Thomas J. Dee & Co. |
| Dental | Goldsmith Bros. S. & R. Co. |
| Excel | Daniels Dental Alloy Co. |
| Fellowship | Dental Protective Supply Co. |
| Garfield's | Garfield S. & R. Co. |
| Mercury Laboratories | Mercury Laboratories, Inc. |
| Minimax | The Minimax Co. |
| Mission | Henry F. Bruce Co. |
| Moyco | The J. Bird Moyer Co. |
| Mynol | Mynol Chemical Co. |
| Ney's C. P. | The J. M. Ney Co. |
| Odontographic | Odontographic Mfg. Co. |
| Research | Precious Metals Research Works, Inc. |
| R. P. C. | Research Products Corporation |
| Spectropure | Baker & Co., Inc. |
| Twentieth Century | The L. D. Caulk Co. |
| Williams | The Williams Gold Refining Co., Inc. (Applies to Williams' one pound bottles only, as quarter pound containers are not glass.) |

CERTIFIED WROUGHT GOLD WIRE ALLOYS (A.D.A. SPECIFICATION NO. 7.)

| Alloy | Manufacturer or Distributor |
|---|---|
| Aderer No. 1 | Julius Aderer, Inc. |
| Aderer No. 3 | |
| Aderer No. 4 | |
| Aderer No. 20 Clasp | |

| | |
|---|---|
| Baker Q. A. | Baker & Co., Inc. |
| Crown Hylastic | General Refineries, Inc. |
| Deepep-Hard | Thomas J. Dee & Co. |
| High Fusing Clasp | Goldsmith Bros. S. & R. Co. |
| Jelenko No. 3 Wire | J. F. Jelenko & Co., Inc. |
| Jelenko Super Wire | |
| Medium Clasp | Goldsmith Bros. S. & R. Co. |
| Ney-Oro Elastic No. 4 | The J. M. Ney Co. |
| Neydium 9 | |
| Regular Clasp | Goldsmith Bros. S. & R. Co. |
| Spyco No. 3 | Spyco Smelting and Refining Co. |
| Spyco No. 4 | |
| Stern No. 2657 | I. Stern and Co., Inc. |
| Williams No. 2 High Fusing Clasp | The Williams Gold Refining Co. |

CERTIFIED ZINC PHOSPHATE CEMENTS (A.D.A. SPECIFICATION No. 8 First Revision)

| Cement | Manufacturer or Distributor |
|---|---|
| Ames Z-M | The W. V-B Ames Co. |
| Bosworth's Zinc | Harry J. Bosworth Co. |
| Caulk Crown and Bridge | The L. D. Caulk Co. |
| Caulk Petroid Improved | |
| Caulk Tenacin | |
| Certicem | Lee S. Smith and Son Mfg. Co. |
| Fleck's Extraordinary | Mizzy, Inc. |
| Lang Dental Crown Bridge and Inlay | Lang Dental Mfg. Co. |
| Moyco Adamant | The J. Bird Moyer Co., Inc. |
| Moyco Inlay Crown and Bridge | |
| Moyco White Copper | |
| S-C | Stratford-Cookson Co. |
| Smith's | Lee S. Smith and Son Mfg. Co. |
| S. S. White Silver "A" | The S. S. White Dental Mfg. Co. |
| S. S. White Silver "B" | |
| S. S. White Zinc | |
| S. S. White Zinc, Improved | |

CERTIFIED SILICATE CEMENTS (A.D.A. SPECIFICATION No. 9.)

| Cement | Manufacturer |
|---|---|
| Astralit | Premier Dental Products Co. |
| Baker Plastic Porcelain | Baker & Co., Inc. |
| DeTrey's Synthetic Porcelain | The L. D. Caulk Co. |
| Durodent Enamel | Oskar Schaefer |
| Smith's Certified Enamel | Lee S. Smith & Son Mfg. Co. |
| S. S. White Filling Porcelain, Improved | The S. S. White Dental Mfg. Co. |

## REPORT OF THE INSURANCE COMMITTEE

*To the Board of Trustees:*

THE Insurance Committee is pleased to report that during the year 1939 a total of 1,363 new applications for A.D.A. Group insurance were received from members. The net gain of insurance in force for the year was $1,400,000; after replacement of the loss through lapses, claims and all reductions in amount of insurance.

The lapse ratio as of January 1, 1940 is the lowest, from the standpoint of both number of members and percentages of insurance, for any year during the past ten years.

The total volume of insurance in force as of December 31, 1939, was $20,126,000. This is an all-time high under the present arrangement, and an increase of more than $6,000,000 during the past

eighteen months. The committee believes that this shows an increased appreciation of the value of the insurance on the part of A.D.A. members.

During the past year, eighty-seven claims were paid for a total amount of $185,812.62. This makes 896 claims paid during the first ten years of operation, totaling $2,037,885.26.

The Insurance Committee is at the present time working out the details of a program of education, advertising and solicitation for 1940. The program will be similar to that followed during 1938 and 1939, which brought such satisfactory results.

Respectfully submitted,
(Signed) A. D. WEAKLEY, *Chairman,*
FRED A. RICHMOND,
*Secretary.*

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## THE NATIONAL HEALTH PROGRAM COMMITTEE

### NEW RULING BY FEDERAL COURT OF APPEALS HOLDS THAT PRACTICE OF MEDICINE IS A TRADE

A DECISION was handed down on March 4 by the United States Court of Appeals which, in effect, rules that the practice of medicine is a trade and, as such, is subject to the provisions of the Sherman Anti-Trust Act. This decision is of interest because it can be applied with equal force to dental practice and because it is unprecedented in American Appelate court history.

In December 1938, the federal government brought indictments against various medical societies and their officers on charges of criminal conspiracy to restrain trade. On July 26 last, Justice Proctor of the District of Columbia Federal District Court dismissed the indictments by holding that the practice of medicine is a profession and that the provisions of the Sherman Anti-Trust Act did not apply to it. On October 23 last, the Supreme Court of the United States refused to review Judge Proctor's decision, holding that the government's appeal must be carried through the Appellate Court before it would review the case. The decision handed down last month was, therefore, a reversal of Judge Proctor's decision. According to officials of the medical association, "it seems reasonable to believe that they will now go to the United States Supreme Court with a request for a definite decision as to whether or not the practice of medicine comes within the purview of the Sherman Anti-Trust law."

The decision, which was the unanimous opinion of the three judges, out of six, who were assigned to hear the case stated:

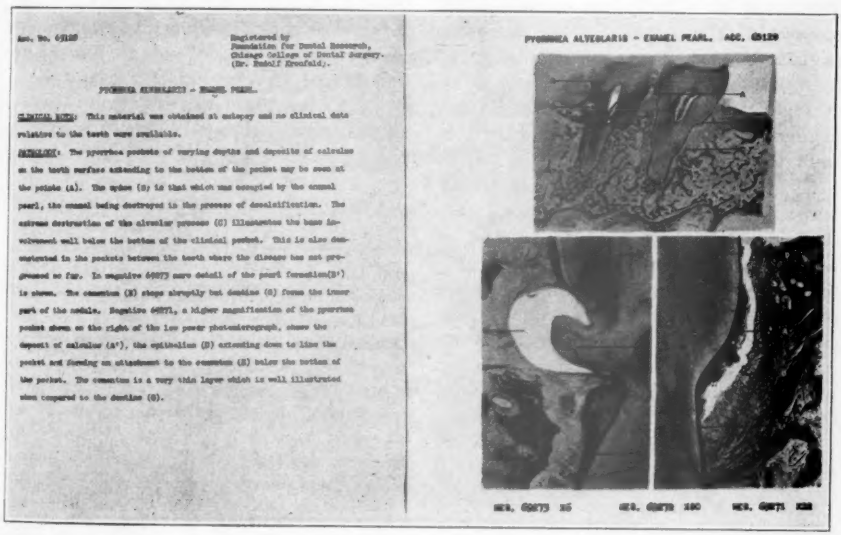
> We think enough has been said to demonstrate that the common law governing restraints of trade has not been confined, as the defendants (medical societies) insist, to the field of commercial activity, ordinarily defined as a "trade," but embraces as well the field of the medical profession. And since, as we think, we are required by the Supreme Court to look to the common law as a chart by which to determine the class and scope of offenses denounced in Section 3 (of the Sherman Anti-Trust Act), it follows that we must hold that a restraint imposed upon the lawful practice of medicine, and *a priori* upon the operations of hospitals and of a lawful organization for financing medical services to its members, is just as much in restraint of trade as if it were directed against any other occupation, or employment or business. And, of course, the fact that the defendants are physicians and medical organizations is of no significance, for Section 3 prohibits "any person" from imposing the prescribed restraints.

# ATLAS OF DENTAL AND ORAL PATHOLOGY

THE Atlas of Dental and Oral Pathology, the preparation of which was authorized by the Board of Trustees at the annual meeting in Milwaukee last year, will be ready for distribution about May 15th. It can be obtained on subscription, price $15.00, to the Secretary, American Dental Association, 212 E. Superior Street, Chicago, Ill. For convenience an order blank is printed below. Because of the nature of the book, the edition is limited.

The Atlas has been prepared at the Army Medical Museum from about 175 of the cases in the Registry of Dental and Oral Pathology of the American Dental Association. These cover comprehensively pathologic conditions of lips, cheeks, mouth, tongue, teeth, jaws and neck which come to the attention of general practitioners and oral and maxillo-facial surgeons. It is not a textbook, but is designed to afford the opportunity to study the pathology of these parts.

The material is presented by the case method with an abstract of the clinical data, clinical photographs and roentgenograms where available, description of the pathology, annotated photomicrographs and references to comprehensive articles in the recent literature where appropriate. The text is mimeographed sheets. These face the plates, which are actual photographic prints. In the accompanying illustration the arrangement is shown.



The book is bound in a durable, gold lettered, loose-leaf binding. There are more than 400 illustrations, making approximately 160 plates. All of the photomicrographs were made at the Army Medical Museum.

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AMERICAN DENTAL ASSOCIATION
212 E. Superior St., Chicago, Ill.

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# COMMITTEE ON LEGISLATION

## *RES IPSA LOQUITUR* AS APPLIED TO DENTAL PRACTICE ACCIDENTS

By Leslie Childs, Indianapolis, Ind.

THE question of the application of the doctrine of *res ipsa loquitur* (the thing speaks for itself) in lawsuits growing out of dental practice accidents is one of importance. If the doctrine is held to apply, proof of the accident, in itself, may be sufficient to support a recovery. If the application of the doctrine is denied, the complaining party must not only prove that there was an accident, but also that it resulted from negligence on the part of the dentist as well.

Clearly, there is a great difference here; and while the courts are not in accord in applying the rule, the trend of what may be termed the weight of authority on the question may be illustrated by a brief review of a few leading cases. As an example of judicial reasoning in which the facts and circumstances were held to justify the application of the doctrine of *res ipsa loquitur,* Bence *vs.* Denbo, 98 Ind. App. 52, 183 N. E. 326, will serve.

### FACTS IN THE CASE

Here the plaintiff applied to the defendant, a dentist, for professional services. While the plaintiff was reclining in a dental chair, face upward, the defendant's x-ray machine, which was suspended above the chair, fell upon the plaintiff and broke her nose. Just how this accident happened, that is, what was the precise cause, does not appear clear in the report.

The plaintiff sued for damages and, among other things, set up a general allegation of negligence as regards the condition of the machine. The plaintiff's injuries, it appears, were quite serious. The case went to a jury and the latter gave the plaintiff a verdict for $3,000. From the judgment on this, the defendant appealed, and the question of the right of the plaintiff to recover, in the absence of direct evidence of negligence on the part of the defendant, under the doctrine of *res ipsa loquitur,* was raised. In reasoning upon this question, and in affirming the judgment below, the higher court, among other things, said:

> The jury, by its answers to the interrogatories, found that the appellant [defendant] had owned this x-ray photographic machine about three years, had taken pictures of his patient's teeth before and had had no accidents with the machine; that it was suspended from the wall, and had an extension, swivel and two hinged joints as part of its mechanical make-up; that there were bolts or rivets in all joints; that the eccentric and swivel joints were not broken; that the machine did fall upon the appellee's [plaintiff's] face and broke her nose; that the appellant or his assistant cleaned the machine daily, and prior to the day of the accident had not discovered any defect. . . .
>
> The appellee, as shown by the answers and general verdict, made a perfect state of facts for the application of the doctrine of *res ipsa loquitur,* it being shown that a bracket, rivet or bolt broke and caused the accident. In other words, the appellee established the facts of the accident itself, and the jury drew the logical conclusion, which was not obviated by any evidence on the part of the appellant.
>
> Even granting that the appellee did not prove by direct evidence exactly how the accident happened, this does not estop a re-

liance upon the presumption of negligence as a fact. . . . The appellee, by her evidence, disclosed that the instrumentality was under the exclusive control of the appellant, and that if due care which was owing had been exercised by the appellant, the accident would not have happened. . . . The judgment . . . is in all things affirmed and it is so ordered.

So too, in Vergeldt *vs.* Hartzell *et al.*, I F. (2d) 633, the question of the application of the doctrine of *res ipsa loquitur* was up for consideration. This was a close case, the facts involved being substantially as follows:

DISK SLIPPED

In this case, the plaintiff was having dental work done by the defendants, which, among other things, involved the setting of a gold inlay. In polishing the latter, the disk slipped off the tooth and inflicted an injury to the plaintiff near the root of her tongue. The plaintiff sued for damages, joining the operating dentist with his employer, another dentist.

On trial, the plaintiff's evidence tended to show that the operating defendant, while polishing the inlay, turned his head toward the instrument stand and, at that moment, the disk slipped from the tooth and penetrated the floor of the patient's mouth. The operating defendant testified that the accident resulted from a movement by the plaintiff of her head, tongue or jaw.

On the foregoing state of the record, the trial court directed a verdict for the defendants on the grounds that the plaintiff had not shown negligence on their part, and that the doctrine of *res ipsa loquitur* had no application to the facts involved. The plaintiff appealed, and the higher court, in reasoning upon this point, and in reversing the judgment, said in part:

It will be observed that this is not an action in which is drawn in question through diagnosis, the method or manner of treatment or operation by a physician or surgeon. The theory of the plaintiff's allegation and brief in support thereof is not that the defendant's treatment or operation was unprofessional or below standard or that the defendant was unskilful in his work, but that the defendant was negligent and failed to observe reasonable care while performing the operation, and, by reason thereof, an untoward act occurred, causing a positive and independent injury.

The position occupied by the plaintiff at the time and the superior opportunity of the defendant to observe and know the real cause of the accident, taken in connection with the accident itself and the apparent involved circumstances, seem to us to make the case one to which the rule *res ipsa loquitur* is applicable. . . .

It would seem to us that the instant case meets all of the requirements. The apparatus was such that no injurious operation or result would be expected unless from a careless user. Both inspection and user were at the time in the exclusive control of [the operating defendant]. . . . It is our judgment that the trial court erred in directing a verdict for the defendants, and the case should be and is reversed.

THE OTHER SIDE OF THE QUESTION

So much for the foregoing decisions, in which the courts applied the doctrine of *res ipsa loquitur*. Now let us turn to authorities on the other side of the question, in which the courts held the doctrine had no application. For this purpose, Bollenbach *vs.* Bloomenthal, 341 Ill. 539, 173 N. E. 670, is in point.

The plaintiff employed the defendant, a dentist, to extract a tooth. The plaintiff was given a general anesthetic, and, during the operation, the crown of the tooth broke into a number of pieces, though the roots came out intact. The defendant attempted to assemble the pieces of the tooth and filling, but they were so small and scattered that there was no way of knowing at the time whether any fragments were missing.

After this operation, the plaintiff suffered a persistent cough. An x-ray examination disclosed a foreign body in a

bronchial tube. Two months later, during a coughing spell, the plaintiff expelled a piece of tooth and filling. Thereafter, the plaintiff brought the instant action against the defendant for damages.

On trial, there was no evidence of negligence on the part of the defendant in extracting the tooth; but the plaintiff relied upon the application of the doctrine of *res ipsa loquitur* in making her case; in other words, that the circumstances of her injury were such as to, in themselves, throw liability therefor upon the defendant.

The trial court sustained this contention, and the trial resulted in a judgment for $8,000 in favor of the plaintiff. The defendant appealed, and the higher court, in reviewing the record and in reversing the judgment, said, among other things:

> An accident happened in the extraction of a tooth, a small piece of tooth and filling going down plaintiff's trachea into her lung and being coughed up some months later. The tooth extracted was a dead one, with a large filling in it. The evidence shows that such teeth are brittle and often break to pieces under the forceps. . . .
>
> No witness, either lay or expert, testified that anything done by [defendant] in extracting the plaintiff's tooth was negligent or unskilful, or that he had omitted to do anything which a reasonably careful and skilful dentist would have done under the same or similar circumstances. . . .
>
> The principle relied upon by the plaintiff . . . is that the doctrine of *res ipsa loquitur* applies where the defendant was in sole control of the acts, instruments and objects involved. . . . Here [defendant] did not have complete control of the tooth in question, but was seeking to get control of it when the crown fractured into many pieces during the extraction. . . .
>
> Thus to say that [defendant] had complete control over . . . the tooth . . . is, under the circumstances, carrying the doctrine of *res ipsa loquitur* entirely too far. . . . Under the circumstances, the trial court erred in giving instructions directing the application of the doctrine of *res ipsa loquitur* and in allowing the plaintiff's attorney to argue it before the jury. . . . Reversed and remanded.

## CONCLUSION

As noted in the beginning, the courts are not in accord in reasoning as regards the application of the doctrine of *res ipsa loquitur* to accidents arising in the field of dental practice. In some jurisdictions, the rule is frowned upon, and the requirement of an allegation and proof of negligence enforced. Generally speaking, the doctrine has no application where an effort is made to base it solely upon an unfortunate result in either diagnosis or treatment.

However, if an accident results through the use of an agency within the exclusive control of the defendant—an accident that patently could not have happened in the exercise of due care on the part of the defendant—the doctrine may be invoked. And, as illustrations of judicial reasoning upon the question, for and against, the decisions reviewed cut squarely across the case law of the subject.

## MALPRACTICE: FRACTURE OF JAWBONE IN EXTRACTION OF TOOTH

THE defendant dentist undertook to extract an impacted wisdom tooth from the plaintiff's lower jaw. In releasing the tooth from the jawbone the defendant struck the chisel with such force that the bone broke. The plaintiff thereafter instituted a malpractice action in the supreme court of New York, New York County. The plaintiff himself, the only witness who testified, described the operation and said that the defendant at the close of the operation admitted that he himself had caused the untoward result by striking the chisel with the mallet "too hard." At the close of the plaintiff's case, the court dismissed the suit. The plaintiff then appealed to the supreme court, appellate division, first department.

The question, said the supreme court, is whether in the absence of expert medical testimony the plaintiff established a prima facie case of lack of ordinary care on the part of the defendant. As a general rule, where the exercise of proper skill or care on the part of the physician, surgeon or dentist is in issue, expert medical testimony is required to show that the untoward results complained of might have been avoided by due care. Expert evidence, however, is not required where the results of treatment warrant the inference of want of care from the testimony of laymen in the light of the knowledge and experience of the jurors themselves. It does not require surgical knowledge or skill, said the court, to apprehend that a result such as occurred in this case would not ordinarily occur if reasonable care had been exercised by the operator. The proof offered by the plaintiff established a prima facie case. What explanation, if any, the defendant might have had for breaking the plaintiff's jawbone was a matter of defense to be developed on the trial. In the absence of proof that this unanticipated result might have happened even though proper care and skill had been exercised, the trial court should not have dismissed the complaint. The judgment of the trial court was therefore reversed and a new trial ordered.

In a dissenting opinion, however, two of the justices took the position that the degree of force to be applied in hammering was a matter of judgment. The defendant applied the chisel at the proper point but erred in his judgment as to how hard a blow he might apply with the mallet. His admission that he hit too hard showed only that he had misjudged the amount of force to be applied. No presumption of negligence should arise from an error of judgment or solely on the basis of an unfortunate result. In the absence of proof of extreme force or expert proof that the force applied was such that a reasonably prudent dentist exercising adequate professional skill should have anticipated an untoward result from it, the plaintiff, in the opinion of these dissenting justices, failed to establish a prima facie case.—*Zettler v. Reich (N. Y.), 11 N. Y. S. (2d) 85.*—*J.A.M.A.*, March 30, 1940.

# CLEVELAND

*Where, long ago, the Eries reigned supreme*
*Have risen stately shafts of stone and steel,*
*Is heard the guttural grind of gear and wheel;*
*A city has surpassed its founder's dream.*
*Majestic ships lift anchor day and night,*
*And while at home its wares receive demand*
*They reach the frozen north and desert sand*
*As fires of forge flare up in fierce delight.*
*Broad boulevards and shapely spires and domes*
*Bestow a touch of elegance and art,*
*While trees and gardens, schools and friendly homes*
*Reveal a conscience and a throbbing heart;*
*Kind host to class and creed of every clime,*
*Stupendous, sedulous, severe, sublime.*

WILLIAM C. STILLSON, D. D. S.

# AMERICAN DENTAL ASSOCIATION

## Eighty-Second Annual Session

### CLEVELAND, OHIO, SEPTEMBER 9-13, 1940

"The Centennial of American Dentistry" is the slogan adopted by the Board of Trustees as the theme for the meeting of the American Dental Association in Cleveland, September 9-13, 1940. In recognition of the pioneers in dental science, literature, education and organization and as a tribute to the Dental Centenary Celebration Committee in Baltimore, who have made it possible to commemorate the achievements of these pioneers, a comprehensive historical exhibit will be held in the Public Auditorium, Cleveland.

That the progress in scientific research of the leaders in dentistry made it possible to recognize the relationship between dental and general health will be emphasized in the scientific, health and historical exhibits. "Dentistry must keep faith with the coming generations of people who will need her services and with the coming generation of practitioners who will administer it."

The Local Arrangements Committee is especially desirous that the 1940 Session keep faith with those instincts which have brought dentistry to its present enviable position. The Cleveland Public Auditorium, the largest in the country, will be utilized to capacity to house the exhibits and scientific sessions, clinics, lectures and demonstrations. All of the facilities for conducting the meeting are within easy walking distance of the leading hotels.

R. E. CREIG, *Chairman,*
Publicity Committee,
10465 Carnegie Ave.,
Cleveland, Ohio

# American Dental Association

## Cleveland, Ohio — September 9-13, 1940

## HOTEL RESERVATIONS

To secure hotel accommodations for the 1940 Session, consult the rate list below and fill out the attached blank. Mail this immediately to the hotel of your first choice or to the Housing Committee, Room 1241, Hotel Statler, Cleveland, Ohio. Confirmation will be sent to you by the hotel.

Second and third choices of hotel should be indicated. If the reservation cannot be made at any of the hotels of your choice, the Housing Committee will place you in as favorable a hotel as possible and will notify you.

Please remember that a reservation constitutes a contract with the hotel to provide you with the accommodations you desire. If you find it impossible to carry out your part of the contract, namely, to occupy the room at the time agreed upon, please write or wire the hotel releasing the room, in order that it may be available for other members.

## APPLICATION FOR HOTEL ACCOMMODATIONS

AMERICAN DENTAL ASSOCIATION

Cleveland, Ohio — September 9-13, 1940

HOTEL.....1st choice

HOTEL.....2nd choice

HOTEL.....3rd choice

Kindly reserve the following: ☐ Single room ☐ Double room ☐ Twin beds.

.....rooms with bath for.....persons $.....per room

.....rooms without bath for.....persons $.....per room

Arriving on September.....at.....a.m.....p.m.

ROOMS TO BE OCCUPIED BY:

| NAME | ADDRESS IN FULL |
|---|---|
| | |
| | |
| | |

NOTE TO HOTEL NAMED AS FIRST CHOICE: If the hotel of first choice is unable to make the reservation requested, this application should be forwarded at once to the Housing Committee, Room 1241, Hotel Statler, Cleveland, Ohio.

# SCHEDULE OF RATES

## ALL ROOMS WITH BATH*

| Hotels | Single | Double | Twin | Suites |
|---|---|---|---|---|
| ALCAZAR HOTEL<br>Surrey & Derberyshire | $3 | $5 | | $12–16 |
| ALLERTON<br>1802 East 13th Street | 2.50–3 | 4.50 | 5–5.50 | |
| AUDITORIUM HOTEL<br>E. 6th at St. Clair | 2.50–3–3.50–4 | 4.50–5–5.50 | 6–7 | |
| BOLTON SQUARE<br>Carnegie at E. 89th St. | | 5 | 6 | |
| CARTER HOTEL<br>Prospect near 9th St. | 2.75–3–3.50–4 | 4–5–6–7 | 6–7–8 | 12–19 |
| CLEVELAND HOTEL<br>Public Square & Superior St. | 3–3.50–4–4.50 | 4.50–5–6–6.50 | 6–7–8–9–10 | 22–30 |
| FENWAY HALL<br>Euclid at University Circle | | | 6–7 | 10–12 |
| GARFIELD HOTEL<br>Prospect at 38th Street | 2.50 | 3 | | 4–6 |
| HOLLENDEN HOTEL<br>Superior at 6th St. | 3–3.50–4–4.50–5–6 | 5–5.50–6–6.50–7 | 6–6.50–7–8–10–12 | 12–40 |
| LAKE SHORE<br>12506 Edgewater Drive | | | | 10–12 |
| MECCA HOTEL<br>1862 East 9th Street | 2 | 3.50–4 | | |
| OLMSTED HOTEL<br>Superior at E. 9th St. | 3 | 6–7 | 7 | 9–10–25 |
| REGENT HOTEL<br>10539 Euclid Avenue | | 3 | 5 | |
| STATLER HOTEL (Headquarters)<br>Euclid at 12th | 3–3.50–4–4.50–6 | 5–5.50–6–6.50–7–8 | 5–5.50–6–6.50–7–7.50–8 | 10–15 |
| STERLING HOTEL<br>Prospect at E. 30th St. | | 5 | 6 | |
| SOVEREIGN<br>1575 East Boulevard | | 5–6 | 8 | |
| STOCKBRIDGE HOTEL<br>3328 Euclid Avenue | 2 | 3 | 4 | |
| TUDOR ARMS<br>Carnegie & 107th St. | 3–3.50 | 5.50 | 6 | 7–12–20–30 |
| WADE PARK MANOR<br>E. 107th & Park Lane | 3.50–4 | | 6 | 8–10–12–15 |
| WESTLAKE<br>Blount Street | 3.50 | 6 | | 12 |

*Rates on rooms without bath by request.

# DENTAL ECONOMICS

## A PRELIMINARY STUDY OF THE ADULT DENTAL NEED

By R. M. Walls,* D.D.S., Bethlehem, Pa.

### Introduction

In both the dental and the medical field, there is a growing demand for exact information regarding the prevalence of various physical problems with which these sciences deal. Until recent years, concentration on the development of technics of cure or the correction of maladies and defects has largely obscured the need for exact knowledge as regards their prevalence. As important as a knowledge of the prevalence of various types of defects is a knowledge of the cost of providing adequate care to meet the need.

The fact that dentists and physicians are raising the question stated above is evidence that they are gaining a broader view of their rôle in society. These professions no longer regard their responsibility as limited to their community and neighborhood: they recognize that it is their function to assist in the solution of the problems of health on a national scale. To accomplish this larger purpose, it is necessary to attack the problems in an organized fashion. However, before an organization for such an undertaking can hope to be effective, it must be armed with facts regarding the extent of the need to be met. While the alert dentist and physician are raising these questions regarding the magnitude of the problems of public health, the information now available on these subjects is still meager and often unreliable.

### Objectives of the Study and Method

Preliminary study of dental need among adults was undertaken by the Economics Committee of the American Dental Association only as an experiment preparatory to a larger study of a similar nature. The survey was directed by the secretary of the Economics Committee, and tabulation of the results, as well as the preparation of the charts and graphs, was the work of an experienced statistician. Both are in charge of the enlarged study about to be undertaken. Through this preliminary survey, much has been learned that will be helpful in planning the future study. Shortcomings in the schedule card used, in the method of presentation of the schedule and in the sampling procedures have been revealed. Some idea has been gained as to the degree of cooperation that can be expected from the dentists from whom the data for the study must be obtained. The findings of this study will also be valuable in checking the results of the study that is about to be undertaken.

Since this preliminary study was conducted on a small scale and is admittedly experimental, it does not purport that the results are truly representative of the average need of the population in general. It should be emphasized that any generalizations based upon these

*Chairman, Economics Committee, American Dental Association.

materials would be hazardous because of the inadequacy of the sample. However, in spite of these shortcomings, the data show a fairly high degree of consistency, which lends some confidence that certain broad trends revealed in the study are indicative of actual trends that will come out, somewhat more refined perhaps, in a larger and more carefully controlled study. This confidence is increased by the fact that, in similar studies, the findings show many characteristics in common with the present study. This report is published partly because of its shortcomings and partly in spite of them. In this way may be shown what can be accomplished by the wholehearted support of the dental profession.

TABLE 1.—AGE AND SEX DISTRIBUTION OF 2,858 CASES INCLUDED IN THE STUDY OF DENTAL NEED IN NEW YORK CITY AND OTHER PLACES

| Age | Male | | Female | | Sex Unknown | |
|---|---|---|---|---|---|---|
| | No. | Per cent | No. | Per cent | No. | Per cent |
| Total | 906 | | 1,141 | | 37 | |
| Under 20 | 93 | 10.2 | 132 | 11.6 | 3 | 8.1 |
| 20–24 | 106 | 11.7 | 193 | 16.9 | 2 | 5.4 |
| 25–29 | 151 | 16.7 | 163 | 14.2 | 2 | 5.4 |
| 30–34 | 102 | 11.2 | 109 | 9.6 | 1 | 2.7 |
| 35–39 | 76 | 8.4 | 137 | 12.0 | 4 | 10.8 |
| 40–44 | 90 | 9.9 | 103 | 9.0 | 2 | 5.4 |
| 45–49 | 69 | 7.6 | 97 | 8.6 | 1 | 2.7 |
| 50–54 | 77 | 8.5 | 67 | 5.9 | 4 | 10.8 |
| 55–59 | 47 | 5.2 | 41 | 3.6 | 2 | 5.4 |
| 60–64 | 30 | 3.3 | 25 | 2.2 | | |
| 65 & over | 15 | 1.7 | 21 | 1.8 | | |
| Unknown | 50 | 5.6 | 53 | 4.6 | 16 | 43.3 |

During the week beginning May 24, 1940, 40,000 survey cards for the recording of data will be placed in the hands of 8,000 dentists, who will be asked to examine five patients and record the result. In order that a representative picture of the country as a whole may be secured, six broad geographic sections have been selected to represent the major cultural, economic and racial groups. Within each of these sections, representative communities of various sizes have been selected, including large, middle and small size cities, as well as villages and farming communities. Thirty states will be included in the survey.

The materials on which the enlarged study will be based were gathered during the first half of the year 1939, in the following manner: Schedule cards containing questions regarding dental needs and certain social data were distributed among a group of dentists selected at random from more than half of the states in the United States. Ap-

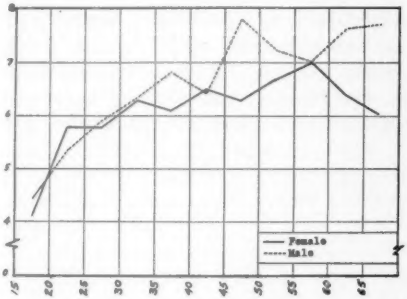


Fig. 1.—Comparable cost of meeting dental needs for 1,141 females and 906 males. The numbers to the left in Figures 1-3 are arbitrary units and not actual cost figures.

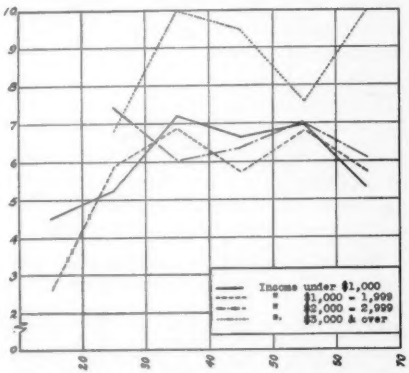


Fig. 2.—Comparable costs of meeting dental needs of 906 males grouped according to age and income. (United States Veterans Bureau fee schedule.)

proximately 6,000 schedules were distributed, of which about one-half were returned. The cards were distributed among the states roughly in proportion to the population of the states. (Table 1.)

About 763 cases were obtained from the dental clinics in New York, N. Y., operated under the auspices of the Works Projects Administration. As the other schedules were distributed among general practitioners rather than in dental clinics, the New York material constitutes a segregated group, which, for the sake of consistency, had to be tabulated separately. Their inclusion in the general sample would have introduced a definite economic bias, since the New York clinic serves only the indigent group. Because of lack of space, the graphs and charts of the New York cases have been omitted.

The study is divided into two sections. The first section deals with the comparative costs of dental care to meet these needs. Determination of the costs was based on a fee schedule used by the United States Veterans Bureau. The second deals with the average dental need in terms of specific needs, such as the average number of fillings required.

Emphasis is placed upon the fact that the selection of the fee schedules utilized in the study was arbitrary and that possibly some other schedule might have been more adequate. However, since it seemed desirable to compare the average cost of dental care for different sex, age and income groups, it was necessary to select some fee schedule that appeared to be representative. No attempt is made to justify this selection. For obvious reasons, no actual costs are being published, yet it is possible to determine, from the tables and graphs, the relationship between the costs in various groups on the basis of age and income.

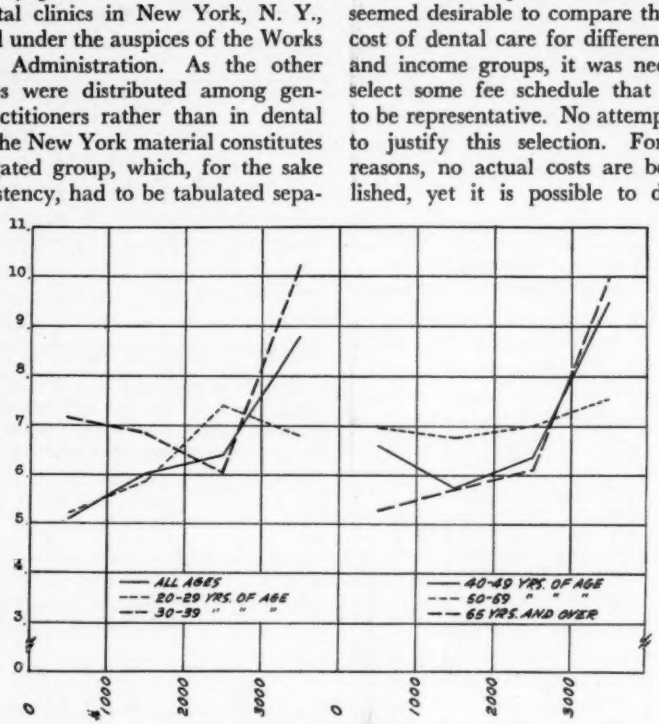


Fig. 3.—Comparable cost of meeting dental needs of 906 males grouped according to age, by income. (United States Veterans Bureau fee schedule.)

Throughout the study, age, sex and income differentials are maintained. The most significant factor in dental need was found, as would be expected, to be age, which was found to influence not only the cost of meeting the dental need, but also the type of need. Income was also found to be an important factor in determining both the cost of meeting and the type of need. The data on

income are limited to the male cases, since the income data were poorly reported in the female cases.

## Part One: Cost of Dental Need Among Females

Consideration of the relationship between age and cost of dental care (Fig. 1) reveals that, in the case of females,

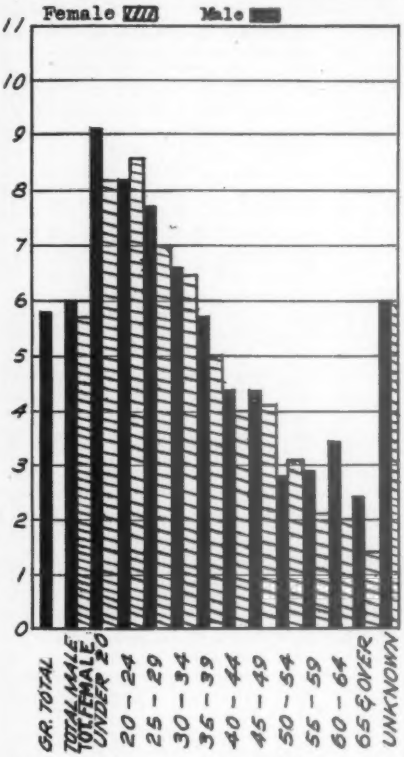


Fig. 4.—Average number of fillings needed, by age groups, for 906 males and 1,141 females.

cost rises precipitously to about the twenty-fifth to the thirtieth year. From that point on, the rise continues, but more gradually, up to about the fifty-fifth to the sixtieth year. Beyond this high point, the curve shows a decline in cost of dental care in the highest age brackets.

As can be seen in the study of specific dental needs, the cumulative deterioration and eventual loss of teeth attendant upon increasing age give rise with increasing age to a need for a more expensive type of dental work, such as bridgework and partial or full dentures. This is clearly demonstrated by Figures 4, 6, 7 and 8, which show a decrease in the number of fillings needed and an increase in the number of extractions with a consequent increase in the need for bridgework and dentures with advancing age. Thus, it can be said that the cumulative deterioration resulting in the need for more expensive types of dental care probably explains the gradual rise in the cost of dental care with increasing age.

The decrease in cost of dental care which occurs after about the fifty-fifth to the sixtieth year is probably explained by the fact that, beyond that age, a large percentage of the population have already acquired full dentures.

Figure 1, which presents the variation in cost of meeting the dental need with age for females, shows a general trend that is quite definite; yet there are several fluctuations between individual age groups which appear to show a periodicity that is at least interesting, if not significant. As has been pointed out, since the sample is small, the fluctuations to which attention is called may be caused by a breaking down of the sample at certain points. With this precaution in mind, questions may properly be raised as to possible explanations of this periodicity in dental needs (assuming the phenomenon to be real).

Can it be possible that physiologic changes, appearing at certain age periods, result in rapid deterioration of the teeth, giving rise to an increased need at these periods? If this should be the correct explanation, it would follow that the interim between the "peak" age groups would represent a period of normalcy, during which the rate of deteri-

TABLE 2.—AVERAGE DENTAL NEED BY TYPE OF NEED IN 2,084 CASES; BY SEX AND AGE

| Age | Total Cases | Average Need | | | | | | | | | | | | | | | Percentage of Cases Needing | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | All Types of Fillings | | | | Amalgam—Fillings | | | | Synthetic—Porcelain | | | | | | | | | |
| | | Total | One Surface | Two Surface | Three Surface | Total | One Surface | Two Surface | Three Surface | Total | One Surface | Two Surface | Three Surface | Total | Extractions | Partial Dentures | Lower Dentures | Upper Dentures | Prophylaxis |
| **Total All Cases** | 2,084 | 5.794 | 3.316 | 2.101 | 0.376 | 3.206 | 1.780 | 1.266 | 0.160 | 1.390 | 1.163 | 0.195 | 0.032 | 0.344 | 2.461 | 0.205 | 12.9 | 08.9 | 72.1 |
| **Total Male** | 906 | 6.019 | 3.504 | 2.120 | 0.396 | 3.314 | 1.865 | 1.282 | 0.168 | 1.404 | 1.198 | 0.187 | 0.018 | 0.392 | 2.759 | 0.204 | 14.4 | 09.1 | 71.9 |
| **Under 20** | 93 | 9.127 | 5.700 | 2.924 | 0.505 | 6.181 | 3.720 | 2.140 | 0.323 | 1.914 | 1.602 | 0.312 | ..... | 0.194 | 0.968 | 0.065 | 02.2 | ..... | 85.0 |
| **20–24** | 106 | 8.242 | 5.111 | 2.735 | 0.396 | 5.215 | 3.310 | 1.707 | 0.198 | 1.773 | 1.481 | 0.273 | 0.019 | 0.377 | 1.716 | 0.075 | 01.9 | 00.9 | 86.8 |
| **25–29** | 151 | 7.659 | 4.614 | 2.483 | 0.563 | 4.283 | 2.390 | 1.655 | 0.238 | 1.721 | 1.562 | 0.252 | 0.007 | 0.371 | 1.569 | 0.106 | 03.3 | 02.0 | 81.4 |
| **30–34** | 102 | 6.610 | 3.773 | 2.362 | 0.470 | 3.665 | 1.891 | 1.548 | 0.225 | 1.607 | 1.470 | 0.078 | 0.059 | 0.353 | 3.028 | 0.255 | 11.8 | 06.9 | 74.5 |
| **35–39** | 76 | 5.681 | 2.893 | 2.420 | 0.368 | 2.722 | 1.236 | 1.354 | 0.302 | 2.157 | 1.973 | 0.105 | 0.079 | 0.473 | 4.063 | 0.342 | 15.8 | 09.2 | 99.9 |
| **40–44** | 90 | 4.366 | 2.489 | 1.578 | 0.300 | 2.078 | 1.011 | 0.933 | 0.133 | 1.311 | 1.167 | 0.144 | ..... | 0.644 | 2.522 | 0.267 | 16.7 | 08.9 | 63.3 |
| **45–49** | 69 | 4.361 | 1.913 | 1.956 | 0.493 | 1.870 | 0.753 | 1.058 | 0.058 | 1.029 | 0.696 | 0.261 | 0.072 | 0.536 | 3.231 | 0.333 | 14.5 | 13.0 | 71.0 |
| **50–54** | 77 | 2.804 | 1.260 | 1.376 | 0.169 | 1.181 | 0.493 | 0.662 | 0.026 | 0.623 | 0.467 | 0.117 | 0.039 | 0.299 | 5.971 | 0.247 | 41.5 | 27.3 | 57.1 |
| **55–59** | 47 | 2.914 | 2.021 | .808 | 0.085 | 1.000 | 0.851 | 0.128 | 0.021 | 0.702 | 0.681 | 0.021 | ..... | 0.468 | 6.168 | 0.319 | 46.8 | 36.2 | 51.1 |
| **60–64** | 30 | 3.433 | 2.000 | 1.067 | 0.367 | 1.733 | 1.100 | 0.533 | 0.100 | 0.733 | 0.667 | 0.067 | ..... | 0.200 | 6.500 | 0.433 | 43.3 | 26.7 | 36.7 |
| **65 & over** | 15 | 2.400 | 1.733 | 0.600 | 0.067 | 0.733 | 0.667 | 0.067 | ..... | 1.133 | 1.067 | 0.067 | ..... | 0.200 | 2.800 | 0.400 | 46.7 | 26.7 | 33.3 |
| **Unknown** | 50 | 6.300 | 3.540 | 2.060 | 0.400 | 2.800 | 1.720 | 0.860 | 0.220 | 1.340 | 1.040 | 0.300 | ..... | 0.320 | 2.420 | 0.180 | 12.0 | 08.0 | 70.0 |
| **Total Female** | 1,141 | 5.863 | 3.330 | 2.155 | 0.377 | 3.258 | 1.804 | 1.294 | 0.160 | 1.446 | 1.190 | 0.211 | 0.045 | 0.315 | 2.255 | 0.211 | 11.7 | 07.1 | 75.0 |
| **Under 20** | 132 | 3.191 | 4.633 | 3.089 | 0.469 | 5.534 | 3.066 | 2.112 | 0.356 | 1.628 | 1.211 | 0.371 | 0.045 | 0.136 | 0.946 | 0.038 | 00.8 | ..... | 87.1 |
| **20–24** | 193 | 8.474 | 5.035 | 3.020 | 0.420 | 5.237 | 2.968 | 2.077 | 0.192 | 1.823 | 1.575 | 0.233 | 0.016 | 0.342 | 1.507 | 0.088 | 2.6 | 00.5 | 81.8 |
| **25–29** | 163 | 6.964 | 4.101 | 2.360 | 0.503 | 3.935 | 2.421 | 1.349 | 0.166 | 1.735 | 1.355 | 0.270 | 0.110 | 0.380 | 1.410 | 0.135 | 2.5 | 01.2 | 86.4 |
| **30–34** | 109 | 6.419 | 3.255 | 2.733 | 0.431 | 3.393 | 1.605 | 1.596 | 0.193 | 1.531 | 1.302 | 0.202 | 0.028 | 0.550 | 1.320 | 0.101 | 3.7 | 01.8 | 75.2 |
| **35–39** | 137 | 4.994 | 2.530 | 2.158 | 0.306 | 2.300 | 0.970 | 1.137 | 0.190 | 1.465 | 1.194 | 0.270 | 0.022 | 0.379 | 1.961 | 0.219 | 10.9 | 06.6 | 78.0 |
| **40–44** | 103 | 4.016 | 2.474 | 1.222 | 0.320 | 1.930 | 1.145 | 0.679 | 0.107 | 1.271 | 1.086 | 0.097 | 0.087 | 0.320 | 3.676 | 0.407 | 19.4 | 11.6 | 66.0 |
| **45–49** | 97 | 4.058 | 2.348 | 1.411 | 0.299 | 2.070 | 1.185 | 0.793 | 0.093 | 0.948 | 0.876 | 0.062 | 0.010 | 0.278 | 3.368 | 0.381 | 17.5 | 10.3 | 76.2 |
| **50–54** | 67 | 3.088 | 1.611 | 1.104 | 0.373 | 1.238 | 0.582 | 0.597 | 0.060 | 1.149 | 0.880 | 0.164 | 0.004 | 0.179 | 4.386 | 0.567 | 26.9 | 17.9 | 62.7 |
| **55–59** | 41 | 2.049 | 1.049 | 0.805 | 0.195 | 0.585 | 0.341 | 0.244 | ..... | 0.659 | 0.610 | 0.024 | 0.024 | 0.195 | 6.439 | 0.341 | 41.5 | 34.1 | 56.1 |
| **60–64** | 25 | 2.000 | 0.840 | 0.760 | 0.400 | 0.560 | 0.320 | 0.240 | ..... | 0.560 | 0.320 | 0.200 | 0.040 | 0.160 | 3.840 | 0.360 | 44.0 | 32.0 | 48.0 |
| **65 & over** | 21 | 1.428 | 0.952 | 0.428 | 0.048 | 0.809 | 0.428 | 0.333 | 0.048 | 0.238 | 0.238 | ..... | ..... | 0.048 | 4.618 | 0.286 | 76.2 | 47.6 | 33.3 |
| **Unknown** | 53 | 6.035 | 3.734 | 2.056 | 0.245 | 2.603 | 1.697 | 0.886 | 0.019 | 1.848 | 1.622 | 0.226 | ..... | 0.339 | 1.433 | 0.207 | 11.3 | 03.8 | 62.2 |
| **Sex unknown** | 37 | 2.360 | 0.860 | 1.340 | 0.160 | 1.280 | 0.380 | 0.840 | 0.860 | 0.400 | 0.340 | 0.060 | ..... | 0.260 | 2.740 | 0.180 | 18.0 | 01.0 | 38.0 |

oration is slowed down. Examination of the graphs on partial and full dentures seems to reveal some degree of association between the need for dentures at given age groups and the cost of dental care for the same age groups. It will probably be pointed out that an increased need for these high-priced restoratives would obviously result in an increase in average cost. The point being made, however, is that a need for these restoratives is indicative of an advanced stage of deterioration, since they are not resorted to unless there have been several extractions.

check-up period. Actually, in the present sample, the "peaks" appear at the age of 32.5, 42.5 and 52.5, which would indicate a lag past the turn of each decade in taking care of dental needs. Evidence to support such a hypothesis is, of course, lacking in this study. In a future study, this theory might be tested indirectly by asking the patient how long it had been since her last visit to the dentist. A tabulation of "length of time since last visiting the dentist by age of patient" would reveal whether people are more or are less likely to visit the dentist during specified age periods.

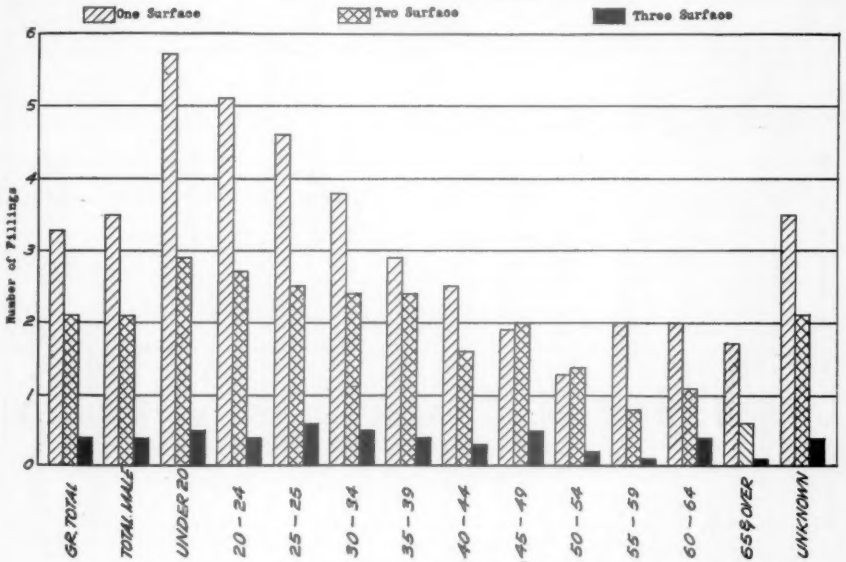


Fig. 5.—Average number of one, two and three surface fillings needed by 906 males.

A second suggestion might be that the fluctuations in cost are caused by the habit of women in general of checking up on the condition of their health, including dental needs, as they reach certain age periods. For example, if it is general practice for women to check up on their health at the turn of each decade in life (twentieth, thirtieth and fortieth year), it is expected that their need would be greatest before each

### COST OF DENTAL NEED AMONG MALES (FIG. 1)

The cost of meeting dental needs among males shows the same general trends observed among females. To be observed is the rather precipitous rise in cost up to the age group 45 to 49. At this high point, the cost drops slightly, and it then levels off. The seeming periodicity observed among the female cases does not appear so markedly among the male

cases. There are fluctuations, but they do not follow any definite pattern. This lack of similarity with the female group would seem to decrease the significance of the apparent periodicity in cost for the female group.

### AVERAGE COST OF DENTAL NEED BY AGE AND INCOME FOR MALES (FIGS. 2, 3)

As was pointed out earlier, income for the female group was very inadequately reported. Consequently, the study of cost related to income is limited to the male group.

When the cases are divided according to income (Fig. 2), the cost curves appear to be divided into three rather distinct groups. The three income groups including under $1,000 up to $2,999 fall closely together and show surprisingly similar characteristics. The $3,000 and over group is widely separated from the lower income group, being higher at every point, with but one exception, than the lower income groups.

Figure 3 gives the data presented by Figure 2 except that, in Figure 3, "age" is held constant and "cost" is shown in relation to "income." That is to say, each line represents a specific age group, and the fluctuations that are observed in cost are caused by "income." Presented in this way, the effects of income on cost can be seen much more readily. It is evident that "cost" rises in most cases with increasing income. The rise in cost between the "$2,000 to $2,999" and the "$3,000 and over" group is observed to be quite marked.

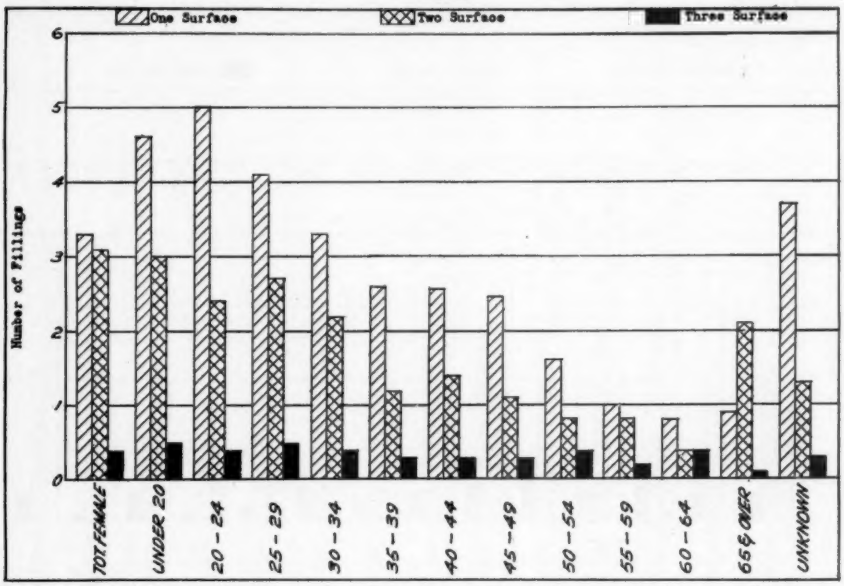


Fig. 6.—Average number of one, two and three surface fillings needed by 1,141 females.

### PART TWO: AVERAGE DENTAL NEED, BY TYPE OF NEED, FOR AGE AND SEX GROUPS (TABLE 2)

The data on specific dental needs by type are much more objective and consequently much more reliable than the data on cost. As has been pointed out, there are so many variables in a determination of cost that any interpretation of the data is difficult. In the case of

specific needs, however, a given dental condition either does or does not exist. This can be determined fairly accurately by careful examination by a competent dentist. Nevertheless, caution should be exercised with even these data, since the particular recommendation of the dentist is to some degree a subjective matter. With allowances for a certain degree of variation caused by the subjective element, confidence in the reliability of the

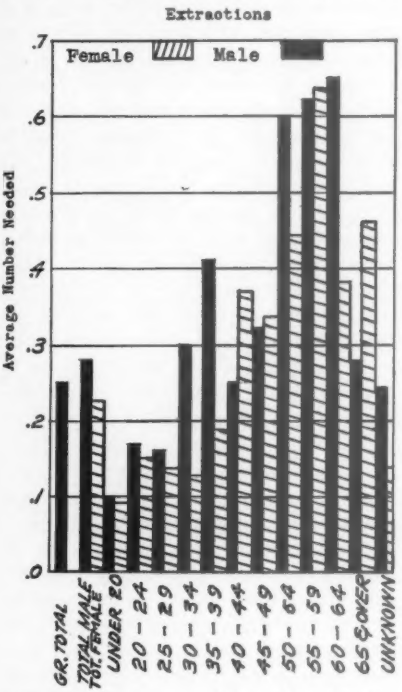


Fig. 7.—Average number of partial dentures and extractions needed, by age groups, for 906 males.

data on specific needs is greatly increased by the fact that, even in this inadequate sample, there is a surprising consistency in the material.

Table 2, on specific needs, gives a "breakdown" of certain needs by type. Under each type of dental correction is given the average need for persons of a given age and sex group. Attention is called to the fact that, under certain needs which represent a single unit, that is to say items of which an individual can have no more or less than one, e.g. full upper or lower denture and prophylaxis, the table gives the percentage of persons in each age and sex group having that need. A little thought will show the logic of this presentation.

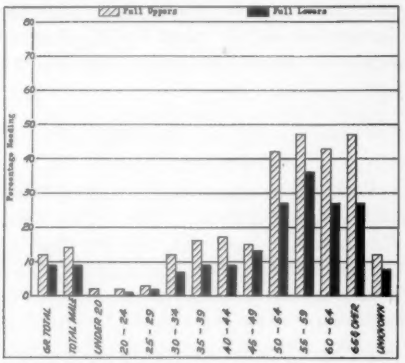


Fig. 8.—Percentage of 906 males needing full dentures, by age groups.

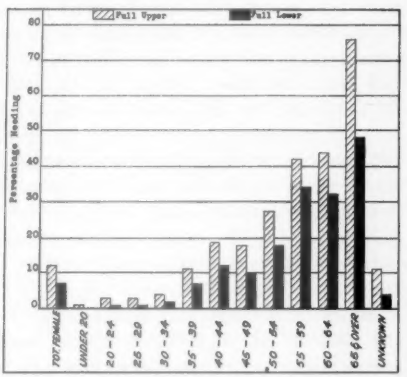


Fig. 9.—Percentage of 1,141 females needing full dentures, by age groups.

The percentage can readily be converted to averages simply by moving the decimal place two digits to the left. To summarize, it can be said that the average need as shown under each item represents the need of the composite man or woman of a particular age and sex group.

### A STUDY OF SELECTED ITEMS OF NEED

Since the entire list of items of need is quite extensive, it has not been possible to list them all, nor will it be practicable to point out the characteristics of each. For the purposes of this article, certain items that seemed more significant were selected for presentation. These items are presented in a series of graphs (Figures 4-9), which show at a glance the fluctuations in the need for the various types of corrections among the various age and sex groups.

### AVERAGE NUMBER OF FILLINGS NEEDED BY AGE GROUPS (FIG. 4)

Perhaps the most positive relationship observed in the entire study is that existing between age and the number of fillings needed. The graphs for both sex groups show essentially the same characteristics. The high point for need in the case of males occurs in the "under 20" group; while, for the females, it occurs in the "20 to 24" age group. From this high point, the average need drops rapidly and continuously, with but few breaks as age advances. As will be pointed out later in more detail, the decrease in the need for fillings is accompanied by a corresponding increase in the need for extractions (Fig. 7). It would appear that, with increasing age, cumulative deterioration makes it increasingly difficult to save teeth by fillings. As a consequence, extraction has to be resorted to.

Some of the minor details in the distribution of age in relation to the need for fillings are rather interesting. It is emphasized again, however, that the discussion to follow is based on conjecture, since, because of the inadequacy of the sample, the characteristics to be observed may be only coincidental.

It is observed, for example, that the continuous downward trend in the average need for fillings in the case of males is interrupted at the age group 45-49 (Fig. 4). The need in this age group, instead of being lower than in the age group preceding it, as was characteristic of all age groups up to that point, equals that of the preceding age group. This fluctuation would not appear in itself to have any significance were it not for the fact that the same phenomenon occurs at this age group for both males and females.

Since, as has been pointed out above, the decrease in the need for fillings is generally accompanied by an increase in the need for extraction, it would be expected that if the reduced rate of decrease in the need for fillings observed at the 45 to 49 age span is real, it should be accompanied by a similar arrest of increase in the need for extractions. In the case of females, this actually happens (Fig. 7). In the case of males, it will be observed (Fig. 5) that, at this age period, the need for two and three surface fillings for the age group 45 to 49 shows a marked increase over the need in the younger age group. These facts would seem to indicate that, at age 45 to 49, deterioration is continuing, but the dentist makes a greater effort to avoid extraction by resorting to larger fillings. This conclusion would seem logical since, by the time age 45 to 49 has been reached, the cumulative extractions have probably considerably reduced the efficiency of mastication. Consequently, the dentist must choose between partial or full dentures or resort to large fillings to save teeth which, could they have been spared, would have been extracted. In other words, the reduced rate of decrease in the need for fillings which is observed at age 45 to 49 would appear to be indicative of a last effort to save enough of the natural teeth to avoid dentures.

### SEX DIFFERENCES IN NEED FOR FILLINGS (FIG. 4)

In almost every age group, males show a higher average need for fillings than do females. The greatest differences occur

among the younger age groups. However, the difference continues to be sizable through the older age groups.

The question which naturally arises is whether the difference in the need of the two sex groups is the result of physiologic conditions or the result of differences in care. In the proposed survey in which the question "How long has it been since the last visit to the dentist?" is asked, some idea will be gained as to the habits of care of the sex groups. This should give at least an indirect answer to the question raised.

### EXTRACTIONS (FIG. 7)

All dental needs such as fillings, extractions and partial and full dentures are so interrelated that, in discussing any one of them, it is necessary to discuss the others also. In the discussion on fillings, much has been said about extractions; consequently, only a brief summary will be made on this item. In general, the number of extractions increases with age.

As would be expected, there is a close relation between the average need for partial dentures and extractions. In fact, the relationship is so close that individual fluctuations of an appreciable size in the average need for extractions is matched by a similar condition in the need for partial dentures.

### FULL DENTURES (FIGS. 8-9)

As was the case in the determination of the need for fillings, the need for full dentures is found to be closely related to age. It is interesting to note that instead of the need increasing gradually with increasing age, the curve seems to rise abruptly at certain widely separated age periods.

The male group shows a very slight need up to the age of 30-34, at which point it rises abruptly. However, the need does not continue to rise until 50 to 54, where it again rises abruptly. Above this age, the need for full dentures fluctuates with increasing age, not showing a continued rise.

The female group follows almost the same pattern shown by the male group except for the fact that there is a lag of five years. That is to say, the abrupt rise in need occurs at 35 to 39 and 55 to 59 in the case of females, instead of 30 to 34 and 50 to 54, as in the case of males.

This phenomenon of abrupt changes in the need for full dentures at given age periods would seem to fit into the earlier discussion on the seeming periodicity of the "check-up" on dental needs as reflected in the graphs on cost.

A comparison of the need for upper and lower dentures shows that the need for upper dentures is consistently much greater than the need for lower. This relationship holds true for all age and sex groups.

In conclusion, I wish to emphasize the statement, made earlier, that since this study was undertaken on a small scale and is admittedly experimental, it does not purport that the results are truly representative of the average need of the population in general. Any generalizations based upon these materials would be unwise because of the inadequacy of the sample.

May I take this occasion to thank the many dentists throughout the country who cooperated in this work, the members of the Economics Committee and others who assisted in various ways. I should like also to call upon those who will be asked to assist in the new survey to give the project their complete cooperation. The success of the new study will depend largely on the degree of participation of the individual dentist.

48 East Market Street.

# Five State Post Graduate Clinic

## WASHINGTON, D. C.
## MAY 19-23

THE District of Columbia Dental Society invites all members of the American Dental Association to attend the eighth annual Five State Post Graduate Clinic at the Willard Hotel, Washington.

Program:

R. E. MORAN, M.D., Washington, D. C., Plastic Surgery Involving Oral Tissues.

ROY J. GLEZEN, D.D.S., Washington, D. C., Immediate Fixed Bridgework.

L. S. BLOCK, D.D.S., and ELAM HARRIS, D.D.S., Louisville, Ky., Study and Treatment of Temporomandibular Joint Problems.

LEROY M. ENNIS, D.D.S., Philadelphia, Pa., The Practical Phases of Roentgenology.

JAMES P. STANTON, D.D.S., Washington, D. C., Rebasing Complete Dentures.

J. L. B. MURRAY, D.D.S., Washington, D. C., Dental Education.

W. W. HURST, D.D.S., Cleveland, Ohio, Immediate Complete Denture Service.

C. C. BASTIAN, D.D.S., New York, N. Y., Ceramics in Dentistry.

HAROLD GOLTON, D.D.S., Baltimore, Md., Diagnosis and Treatment Planning of Periodontal Diseases and Diseases of the Oral Mucous Membranes.

J. M. CLAYTON, D.D.S., Kansas City, Mo., Children's Dentistry.

R. E. RAMAKER, D.D.S., Seattle, Wash., Correction of Arch Deformities in the Infant.

M. G. SWENSON, D.D.S., New York, N. Y., Complete Dentures.

In addition to these essays, there will be registered and table clinics. There will be golf, a Calcutta Pool, "Stag Night Frolic," a dinner dance, a lecture by Elmer Wheeler on psychology and salesmanship and sightseeing trips to the Federal Bureau of Investigation and other points of interest.

DAVID J. FITZGIBBON, *Chairman,*
Publicity Committee,
1801 Eye St., N.W.,
Washington.

# DEDICATION OF THE W. K. KELLOGG FOUNDATION INSTITUTE FOR GRADUATE AND POST-GRADUATE DENTISTRY

At the University of Michigan, Ann Arbor, April 3, 1940, there was dedicated, to the furtherance of the cause of dental care, the W. K. Kellogg Foundation Institute, for the promotion of graduate and postgraduate dental education under the sponsorship and direction of the school of dentistry of the university.

Before a specially invited audience in the lecture hall of the Rackham Building of the university, Emory K. Morris, treasurer and associate director of the W. K. Kellogg Foundation, presented the magnificent building which will house the new activity to the president, Alexander G. Ruthven, who accepted it on behalf of the regents as part of the educational facilities of the university.

Expressing the foundation's interest in dentistry and the reasons for the construction of the new institute, Dr. Morris explained that the institute represents one more step toward securing better health for the people of Michigan. He indicated the pride of the foundation in thus being able to contribute to the welfare of the public through the dental profession.

In accepting the institute, the president remarked that institutes of higher education are service agencies with the mission of increasing and spreading human knowledge. It is the duty of these institutions, he said, not only to prepare youth for adult life, but also to aid in adult education. It is only when the institution meets both these demands, he concluded, that it is truly a university.

Russell W. Bunting, dean of the dental school, in responding to the gift on behalf of the faculty of the school of dentistry, declared that the institute was a dream of the faculty of the dental school realized and that the day was a memorable one in the history of the dental school and dentistry at large. He said:

> The faculty of the dental school is grateful to the Kellogg Foundation and to the United States Government for this munificent gift. We are proud that the University of Michigan was chosen as the recipient. We are impressed and made humble by the responsibilities and obligations laid upon us by the gift; but we accept these responsibilities and obligations and will do all that we can to advance dental education.

Speaking for the department of postgraduate dentistry, Paul H. Jeserich, director of the institute, emphasized the fact that Michigan has been a pioneer in dental education and stressed the point that this pioneering is shared by the dental profession as well as the university. He expressed the further hope that the new institute would inspire the profession to continue to pioneer.

Clarence S. Yoakum, dean of the graduate school and vice-president of the university, spoke for the graduate school, maintaining that the Kellogg Foundation was worthy of the highest praise because of its efforts in discovering new technics of thinking and doing. He expressed the hope that the institute would advance instruction and research.

Thomas Reid, representing the Public Works Administration, which participated in financing the new dental educational project, noted with pleasure the harmonious cooperation among the university, the Government and the Kellogg Foundation.

Oliver W. White, of Detroit, speaking for the dental alumni, pledged the inter-

ested and enthusiastic support of all Michigan's dental alumni in rendering service to the university and dentistry in keeping with the spirit of the gift.

Dr. White was honored by the university with the master of science degree, an honor well deserved by one who has done much toward the development and promotion of postgraduate education in Michigan.

After the dedication exercises, the dental alumni celebrated their annual homecoming in a meeting at which Clarence O. Simpson, of St. Louis, Mo., spoke on "Perplexing Radiographic Evidence."

In the afternoon, the alumni association unveiled the memorial to Willoughby D. Miller, one of the most noted of Michigan's alumni, and one who contributed much to the science of dentistry and bacteriology. Dr. Miller, it will be recalled, was elected to the deanship of the dental school, but died before he could assume office.

The dedication of the Kellogg Foundation Institute was indeed a gala occasion for the dental school of the University of Michigan, for the University of Michigan and for dentistry and the dental welfare of the people of Michigan, and a notable event in dentistry at large, in that dentistry as a health service has received substantial recognition and support from the great philanthropic institution established by William K. Kellogg.

We are sure that the obligations which such a rich benefaction places upon dentistry will be fulfilled in the furtherance of the benefits which dentistry can bestow as a public health service.

## EIGHTH AMERICAN SCIENTIFIC CONGRESS, DEPARTMENT OF STATE, WASHINGTON, D. C., MAY 10 TO 18, 1940

THE Eighth American Scientific Congress will meet in Washington, D. C., May 10 to 18. Thomas Parran, Surgeon General, United States Public Health Service, chairman of Section V, Public Health and Medicine, of the Congress, has extended to Arthur H. Merritt, President of the American Dental Association, and other members of the Association, a cordial welcome to attend the meetings and participate in the discussions.

Dr. Merritt has been appointed by the Secretary of State a member of the Advisory Committee, composed of officials of the Government and distinguished leaders from the fields of science and education.

### Tentative Outline of Program for Section V

Saturday, May 11 a.m. General topic: Education. The bearing of popular, higher professional and special education upon medicine and public health. (Joint session with Section on Education.)

Monday, May 13 p.m. General topic: Nutrition. Relation between nutritive state and some aspects of heart disease. Relation between drinking water and dental caries and mottled enamel.

Tuesday, May 14 a.m. Joint session with Section on Statistics.

May 14 p.m. Visit to National Institute of Health. Observation of current investigations in many branches. Visitors may, if they desire, concentrate on subjects of personal professional interest.

Wednesday, May 15 a.m. General topic: Tuberculosis. Social and economic factors in etiology. New methods of treatment.

May 15 p.m. General topic: Chemotherapy. Chemistry and pharmacology of new compounds. Clinical application to infections with streptococci, gonococci,

pneumococci and meningococci to lymphogranuloma venereum and other infections.

Thursday, May 16 a.m. General topic: Heart Disease. New conceptions from clinical viewpoint.

May 16 p.m. General topic: Cancer. Present status of experimental cancer. Organization for the study of cancer and its control. Newer aspects of therapy.

Friday, May 17 a.m. General topic: Tropical and other diseases. Summaries and new contributions on yellow fever, pinto, leprosy, undulant fever, rickettsial diseases and plague.

## IDENTIFICATION SOUGHT

THE Federal Bureau of Investigation is endeavoring to apprehend William Andrew Murray, who was indicted by a Federal Grand Jury at Erie, Pa., March 17, 1936, being charged with a violation of the National Bank Act.

In this indictment, Murray was charged with embezzling various sums of money from a Butler County, Pennsylvania, bank, where he had been employed as a note teller. He was also charged with making various false entries for the purpose of covering up his defalcations. The accompanying chart is presented in the event that a reader may have a record or any knowledge of Murray.

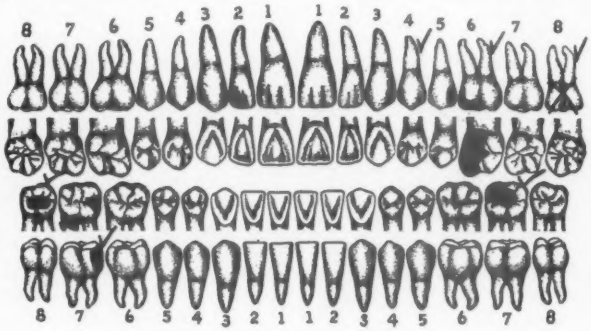


Fig. 1.—Teeth 5 and 6, gold fillings; others, amalgam.

The description of Murray is as follows:

Name, William Andrew Murray.
Age, 39 (Born October 7, 1900, Parkers Landing, Pa.).
Height, 5 feet, 11 inches.
Weight, 160 pounds.
Build, tall, slender.
Hair, blond, partially bald.
Eyes, blue.
Complexion, light.
Scars, boil scars on back of neck.
Occupation, bank clerk.
Marital status, single.
Race, white.
Nationality, American.
Criminal record, none known.

In the event that any information is obtained concerning Murray, it is requested that the nearest office of the Federal Bureau of Investigation be contacted immediately, or that the information be furnished direct to Mr. John Edgar Hoover, Director, Federal Bureau of Investigation, U. S. Department of Justice, Washington, D. C., or to Special Agent in Charge, Federal Bureau of Investigation, 1900 Bankers Building, Chicago, Ill.

# OBITUARIES

## GEORGE B. WINTER, D.D.S., F.A.C.D.

(1878-1940)

Died, March 28, 1940, at his home in St. Louis, Mo., George Ben Wade Winter, D. D. S., F.A.C.D.

Dr. Winter was born in Brooklyn, N. Y., April 4, 1878; his father was a newspaper publisher who settled in St. Louis in the early eighties. He obtained his early education in the elementary and high schools of St. Louis. Soon after completing his professional education, at the St. Louis University, from which institution he graduated in 1900, he became a teacher in the St. Louis University, and some years later, became professor of exodontia at the Washington University School of Dentistry, St. Louis.

After a few years in general practice, he became interested in the surgical phase of dentistry and soon specialized in the extraction of teeth. Being much impressed with the crudeness of the methods then employed, he spent some four years in intensive research in the principles involved in the removal of teeth and evolved a scientific basic principle of tooth movement during extraction.

In 1913 he published his findings and methods in a textbook, which became the leading textbook in its field. Dr. Winter devoted the larger part of his energies and time to the promotion of his methods of tooth removal, during which time he traveled extensively and gave instructions in every part of the United States and in many foreign countries. His individual efforts entirely revolutionized this phase of dental surgery and his individual skill in the removal of the third molar tooth became world famous. He published several works on the subject and his perfection of the operation was responsible for the specialty of Exodontia.

Dr. Winter did not, however, confine his interest entirely to the removal of teeth: he was a constant and enthusiastic proponent of dentistry and was interested in the promotion of its every phase.

His intense and whole-hearted interest in dentistry was abundantly demonstrated in 1936 when he served the American Dental Association as President. During his tenure of office he gave unstintingly of his time and energy to his duties as President and has for the years since maintained an enthusiastic interest in the welfare of the Association. He was ever a wise counselor and a champion of all that relates to dentistry.

He served his local profession in almost every capacity and received many awards of honor and recognition from every part of the globe.

Dr. Winter was past President of the American Dental Association; Professor of Exodontia, Washington University School of Dentistry, St. Louis; recipient of the Newell Sill Jenkins medal for outstanding contribution to dental science, 1933; recipient of a gold medal and scroll from the Rhode Island State Dental Society for outstanding research, 1936; recipient of a gold medal from the Odontological Society of Havana, Cuba, 1938; author of the books "Exodontia" and "The Impacted Mandibular Third Molar" and author and narrator of the sound-on-film motion picture, "Fundamental Principles for the Technical Removal of the Mandibular Third Molar." He was an honorary member of the American Dental Society of Europe; the American Dental Society of the Argentine Republic; Sociedad Odontologica Cubana; Sociedad Odontologica de Chile; La Sociedad Odontolojica de Valparaiso; Academia de Estomatologica del Peru; Centro de Odontologica del Uruguay; Associacion Odontologica de Chile; Ohio State Dental Society; Oregon State Dental Society; Oral Surgery Section, Second District Dental Society of New York; member of Omicron Kappa Upsilon honorary dental fraternity.

He was past President of the Missouri State Dental Association; past President St. Louis Dental Society; past President Alumni Association of St. Louis University; Fellow

of the American College of Dentists; former teacher, Officers School of Neurological, Plastic and Oral Surgery, established by order of the Surgeon General of the Army, World War; former Professor of Exodontia, St. Louis University School of Dentistry; former teacher Columbia University Extension Course. He gave clinics at Guys Hospital, London, England, and the American Hospital, Neuilly, France; research reports at the International Congress, Paris, France.

Dr. Winter's genial personality and his many sterling traits drew to him innumerable friends wherever he went, and he went everywhere, in demonstrating by moving pictures and clinically his methods of procedure. The lovable personal side of his character may best be portrayed by the personal tribute of one who was associated with him for many years and who learned to know his every good quality.

"There is hardly a member of the dental profession, either in this country or abroad, who is not familiar with the great work Dr. Winter has done for the profession and for organized dentistry. I feel that the twenty-five years during which he was my teacher, friend and associate have been a rare

GEORGE B. WINTER, D.D.S.
(1878-1940)

privilege and look back upon those years with pride and the knowledge that the inspiration gained from them will remain with me throughout my life.

"Dr. Winter's friends knew him as a clear thinker, possessed of amazing powers of concentration, and it was this ability that enabled him to create the specialty of exodontia. It was a maxim of his that no research work was ever complete but could always be improved, and he worked toward that end all of his life. Dr. Winter accomplished more work during his lifetime than the average man and drove himself relentlessly, not only in his own specialty but in all of the many activities in which he was engaged. No task was ever too great and no burden too heavy when he could be of help, either to the individual or to his profession.

"He was never too busy to give time to the other man's problems and his patience in this respect endeared him to many who sought and received his advice and counsel. It would be difficult indeed to count those to whom he has lent a helping hand, as he was far too modest and unassuming to claim the credit due him.

"In his unflagging pursuit of knowledge he was utterly unselfish. Firm in the conviction that the cause of humanity should be his first objective, he communicated his knowledge to others in order that the benefits of his labors might be as widely spread as possible. I assisted him when he gave his first post-graduate clinic at St. Louis University in 1917, and, even at that early period, his teaching was an inspiration. The twenty-one years of our association in practice, working side by side every day, I know to be years of constant, unremitting effort on his part to further the advance of dental science and of exodontia in particular.

"Work was Dr. Winter's only true hobby and, because of his habitual reserve, many thought him incapable of relaxation. However, those close to him knew him to be genial and kindly, fond of good conversation and with a sound sense of humor. He loved travel and made a host of friends all over the world.

"Dr. Winter will ever occupy a high place in dentistry's Hall of Fame, as well as in the hearts of those who admired and respected him. His loss is a great blow to dentistry and the only way in which we can, in some measure, pay the debt we owe for his achievements is to emulate his untiring efforts for the advancement of the profession to which he devoted his life."

RALPH B. RODE.

## CHARLES McMANUS, D.D.S.
## (1865-1940)

CHARLES MCMANUS died April 3 at his home in Hartford, Conn., where he had practiced for fifty years.

Dr. McManus was born in Hartford, August 6, 1865, the son of James McManus, a leading dentist in Hartford, and Ellen (Fagin) McManus. He received his professional education at the Philadelphia Dental College, where he was graduated in 1888, and began practice in Hartford in 1895.

Joining the Hartford Dental Society as a charter member in 1897, he served as its librarian and curator from 1908 to 1911 and as a trustee from 1920 to the time of his death. Since 1935, he had been a member of the Horace Wells Memorial Tablet Committee.

Always a stanch supporter of Dr. Wells in the controversy as to the discovery of anesthesia, Dr. McManus also was a charter member and had served as secretary of the Horace Wells Club.

His father was one of the founders of both the state and local dental societies.

Dr. McManus is survived by his wife, Mrs. Frances Stone McManus; a brother, Dr. Henry McManus, of Washington, D. C., and several cousins, among them James Goodwin McManus, the artist.

## G. EDGAR WEST, D.D.S.
## (1874-1940)

G. EDGAR WEST died at his home in Memphis, Tenn., January 15, at the age of 66.

Dr. West was born in Pontotoc, Miss., in 1874. In 1896, he was graduated from the Atlantic Dental College, and began the practice of dentistry, at Kosciusko, Miss., later moving to Clarksville, Texas. From there, he went to Memphis, Tenn., where he practiced thirty-eight years.

Dr. West was one of the pioneers in dental ceramics, attaining an outstanding position in his chosen field. He was a past president of the Memphis Dental Society, a Mason, a

Knight Templar and a member of the Presbyterian Church.

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## ALFRED PYLE LEE, D.D.S., F.A.C.D.
## (1871-1940)

ALFRED PYLE LEE died April 8, in Jefferson Hospital, Philadelphia, of anemia, after an illness of several years.

Dr. Lee was born near Oxford, Pa., in 1871, and, after attending the public schools in Oxford, he learned the printing trade, at the Oxford Press. He later worked on the *Philadelphia Inquirer,* attending the dental school at the University of Pennsylvania while operating a linotype at night. He graduated in the class of 1900 and immediately was appointed instructor at the university. Later, he served as lecturer and associate professor of materia medica. He was appointed to the Pennsylvania Board of Dental Examiners in 1918 and served until 1930, when he resigned on account of ill health. He was at one time president of the board.

Dr. Lee was a member of the Philadelphia County Dental Society, the Pennsylvania State Dental Society, the American Dental Association, the Academy of Stomatology, the Pennsylvania Association of Dental Surgeons and the Odontographic Society and was a former president of the National Association of Dental Examiners, the Pennsylvania Association of Dental Surgeons and the Alumni Society of the University of Pennsylvania.

He was a Fellow of the American College of Dentists, a member of Omicron Kappa Upsilon, chairman of a section in the International Dental Congress in 1926, Supreme Councilor of the Psi Omega Fraternity and editor of the *Frater,* Psi Omega magazine, and the *Dental Brief.* He collected an extensive library of dental books and also had a large collection of first editions of famous writers. He compiled and printed a bibliography of the life and works of the novelist Christopher Morley and had a complete set of his works.

As a student, dentist, teacher, lecturer, editor, writer, examiner, fraternity man, friend, good fellow, Alfred Pyle Lee was equaled by few and excelled by none.

A. H. R.

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# DEATHS

AIGLEY, JOHN EMANUEL, Farmington, Ill.; Chicago College of Dental Surgery, 1896; died recently; aged 77.

BARKER, ALTON, Denver, Colo.; State University of Iowa, College of Dentistry, 1890; died recently; aged 73.

BOYD, C. L., Auburn, Ala.; Vanderbilt University School of Dentistry, 1889; died February 4; aged 79.

CORMICAN, H. L., Waupaca, Wis.; Indiana University School of Dentistry, 1890; died January 15; aged 71.

DUBOIS, DWIGHT W., Roann, Ind.; Indiana University School of Dentistry, 1907; died March 8; aged 56.

EPLEY, HENRY CLIFFORD, Jefferson, Ore.; died February 5; aged 71.

GATTERDAM, J. H., La Crosse, Wis.; Marquette University Dental School, 1913; died January 28; aged 50.

HAWKE, WILLIAM W., Flemington, N. J.; University of Pennsylvania School of Dentistry, 1885; died April 4; aged 75.

KAYSER, KARL H., Indianapolis, Ind.; Indiana University School of Dentistry, 1916; died March 9; aged 55.

LEMLEY, BURTON E., Tacoma, Wash.; Tacoma College of Dental Surgery, 1898; died March 20; aged 74.

MCPHEE, JOHN, Inglewood, Calif.; Chicago College of Dental Surgery, 1899; died February 28; aged 71.

O'CONNOR, EUGENE L., Jackson, Mich.; University of Michigan School of Dentistry, 1913; died January 13; aged 49.

PAISTE, JAMES L., Avondale, Pa.; University of Pennsylvania School of Dentistry, 1888; died January 31; aged 72.

SMALL, B. A., Greeley, Colo.; State University of Iowa, College of Dentistry, 1902; died in January.

TOCCI, ALBERT MARK, Hurley, Wis.; Marquette University Dental School, 1926; died January 1; aged 38.

WREN, EDWIN S., (LT. COL.), Ruxton, Md.; University of Pennsylvania School of Dentistry, 1909; died November 14, 1939.

# CURRENT LITERATURE

## Experimental Dental Caries. III. A System of Recording Corn Meal Caries in Rats

By GERALD J. COX, MARY L. DODDS, SARA F. DIXON and MARGARET C. MATUSCHAK

THIS paper gives in detail the method used by the authors in recording and evaluating results in experimental rat caries. In all cases, coarse corn meal diets were used to initiate caries. Studies have been made as to the production of teeth more resistant to destruction as well as to the influence a change in diet exerts. The time of experimental runs is completely standardized. The system of recording is based upon the incidence of caries in susceptible areas of the teeth. "Occlusal" and "fissure" type caries are differentiated and each is given more detailed description and classification. The punched card system is used and all twelve molars are considered. Successive plane sections are obtained in series and each tooth is evaluated after grinding. The data are easily and rapidly adapted to a thorough statistical interpretation and results are summarized as to odds that the occurrence of differences of mean incidence of caries is not due to chance.—*J. D. Res.*, 18:469, December 1939.

VIRGIL D. CHEYNE.

## Inhibition of Experimental Dental Caries by Fluorine in the Absence of Saliva

By VIRGIL D. CHEYNE

ALTHOUGH the inhibition of dental caries by the ingestion of fluorine has been demonstrated in endemic areas (H. T. Dean, *Pub. Health Rep.*, 53:1443, 1938) and in laboratory rats fed on a caries-producing diet (B. F. Miller, *Proc. Soc. Exper. Biol. & Med*, 39:389, 1939), the exact mechanism by which the action takes place has not yet been adequately demonstrated. A high fluorine content of teeth has been postulated by Armstrong and Brekhus (*J. D. Res.*, 17: 393, 1938) as a possible factor in this phenomenon. Likewise, emanating from this suggestion, there are *in vitro* studies inclined to regard the possibility of incorporation of fluorine in sufficient amount in the tooth surface, after calcification, to account for increased resistance to the mechanism responsible for decalcification.

In this experiment, attention has been called to the rôle exerted by saliva. An attempt is made to differentiate systemic and local influences in the problem. The "Cheyne rat" (*J. D. Res.*, 18:457, 1939), which naturally has a high caries index, being desalivated, exhibited a reduction of 80-85 per cent of the carious afflictions, as contrasted to desalivated controls, when given a drop of water containing 3 mg. of fluorine on the tongue every twenty-four hours. The findings indicate that the fluorine is effective even when oral secretions are at a minimum. It is concluded that the action of fluorine in retarding the progress of decay is direct and persistent on the tooth or in the region where food and bacteria come in contact with the tooth surface.—*Proc. Soc. Exper. Biol. & Med.*, 43:58, January 1940.

B. P. KEARNEY.

## Action of a Quaternary Ammonium Type of Wetting Agent on Metabolism of Micro-Organisms Associated with Dental Caries

By BENJAMIN F. MILLER, ZELMA BAKER and R. W. HARRISON

IN searching for a compound that could inhibit the metabolism of micro-organisms found in the lesions of dental caries or in plaques associated with such lesions, the authors have studied the action of alkyl dimethyl benzyl ammonium chloride (zephiran) on these bacteria. The rate of respiration or glycolysis of pure cultures of five micro-organisms, which are found constantly or very frequently in association with human dental caries, were measured in Warburg vessels. Strains of the lactobacillus, *G. tetragena*, the staphylococcus, a gram-positive oral diplococcus and monilia were studied.

They were subjected to a one-ten-thousandth molar solution of the drug for a few minutes, washed and placed in fresh glucose-buffer solution and the percentage of inhibition per sixty minutes calculated. The authors have previously studied fluoride and iodoacetate, but because of the unusual inhibiting action of "zephiran," its excellent powers of penetration and cleansing and its low toxicity for mucous membranes, this substance appears to deserve considerable study.—*Proc. Soc. Exper. Biol. & Med.*, 42: 705, December 1939.

VIRGIL D. CHEYNE.

## Focal Infection and Systemic Disease: A Critical Appraisal

By H. A. REIMANN and W. P. HAVENS

THE concept of focal infection in relation to systemic disease is firmly established. The origin of many toxic or metastatic diseases can be traced to primary local or focal infection. The results of routine extraction of teeth and tonsillectomy for the purpose of preventing or curing systemic disease indicate, in the minds of many, that the practice is not justified. Controlled clinical and experimental support of the procedure is lacking. Comparing the occasional benefit obtained with the dangers incident to the operation, one is led to recommend extraction of teeth and tonsillectomy only in exceptional cases, when evidence of actual local disease is present and its relation to remote or systemic disease seems probable.

If the presence of an abscess or chronic infection around a tooth is reasonably certain, there is no question that surgical measures are necessary in treatment of the local condition. But, in the light of present knowledge, the elimination of local infection in the hope of influencing remote or general symptoms must still be regarded as an experimental procedure not devoid of hazard.

The authors conclude: "It may be said, therefore, that: (a) the theory of focal infection, in the sense of the term used here, has not been proved; (b) the infectious agents involved are unknown; (c) large groups of persons whose tonsils are present are no worse than those whose tonsils are out; (d) patients whose teeth or tonsils are removed often continue to suffer from the original disease for which they were removed; (e) beneficial effects can seldom be ascribed to surgical procedures alone; (f) beneficial effects which occasionally occur after surgical measures are often outweighed by harmful effects or no effects at all, and (g) many suggestive foci of infection heal after recovery from systemic disease or when the general health is improved with hygienic and dietary measures."—*J.A.M.A.*, 114:1, January 6, 1940.

M. K. HINE.

## Fluoride in Drinking Water and Dental Caries

By C. A. MILLS

LEST a favorable verdict be found for the caries-preventing influence of fluoride in drinking water before sufficient evidence on the point has been accumulated, I would like to sound a note of caution. Dean and his co-workers did sound a faint warning in the report on their Illinois study *(Pub. Health Rep.* 54:862, May 26, 1939), and in *The Journal* editorial, September 16, page 1132, the reader was again cautioned that some water constituent other than fluoride might possibly be the caries inhibiting agent. So far as human caries statistics are concerned, no greater importance can be attached to the fluorine content of drinking water than to its total hardness. In 1937 I pointed out an inverse relationship between the incidence of caries and the hardness of drinking water in some seventy-five American cities *(J. Dent. Research* 16:417, October, 1937) and the observations of Dean and his associates bear mine out quite well. Caries was found much more prevalent among the school children of Macomb and Quincy than among those of Galesburg and Monmouth, but the latter two cities use very hard well water, with a high content of the salts of alkaline and alkaline earth metals (1,005 and 989 parts per million total fixed residue) in addition to a high fluoride content. Macomb and Quincy use river water of very low fixed residue (165 and 129 parts per million) along with a low fluoride content. In the regions of occurrence of mottled enamel and water high in fluoride content there is always an accompanying high degree of total hardness in the drinking waters.

Evidence from studies on experimental animals does seem to indicate a fluoride protection against caries, but the case for fluo-

ride protection in man cannot be considered closed until the fluoride effect has been completely dissociated from the complicating influence of total hardness. The statement of Cox *(The Journal,* November 4, p. 1753) that "the case should be regarded as proved" seems somewhat premature.—Correspondence, *J.A.M.A.,* 114:179, January 13, 1940.

M. K. Hine.

## Normal Blood Pressure

Much difference of opinion prevails as to what constitutes normal blood pressure; obviously the pressure can vary widely among different individuals of the same age groups or in the same individual at different ages and under altered circumstances. A recent study of this subject by Robinson and Brucer[1] has tended to revise downward generally accepted normal blood pressure levels. These authors made an exhaustive statistical study of 7,478 men and 3,405 women, all relatively sedentary in their occupations, selected at random in the Chicago area and economically selected by being able to afford insurance policies of $1,000 or more. Eighty-six per cent of the men had systolic blood pressures of between 90 and 130 mm. of mercury, 54 per cent between 100 and 120, 6 per cent below 100 and 25 per cent below 110. Of the women, 89 per cent had systolic pressures of between 90 and 130, 56 per cent between 100 and 120, 18 per cent below 100 and 44 per cent below 110. The greater tendency to low blood pressures in the women was found in the younger age groups. Up to the age of 60, half or more of the men had systolic pressures lower than 120, and that of about three-fourths never rose above 130. The indications are, they say, that hypertensive men are those who have systolic pressures above 120 appearing at an early age. The authors also presented the continuous blood pressure history of 500 apparently well men examined annually over a period of about ten years. Blood pressures consistently low did not show as much change from year to year as those consistently high. Persons with systolic pressures below 120 rarely changed their level in the direction of a steady rise. In the third phase of this study Robinson and Brucer pointed out that deviations from physiologic norms represent the most accurate check on degenerative processes at work and of potential longevity. If the upper limits of normal pressures are set at 120 systolic and 80 diastolic, a definite parallelism could be observed with the actuarial figures of insurance companies. With a rise in blood pressure there was an abrupt rise in death rate. Pressures, they conclude, of 130 to 144 systolic and diastolic pressures of over 80 cannot be regarded as normal. Accordingly, the popular notion that low blood pressure is a disease and moderately high pressure normal and safe is fallacious. On the contrary, they say, longevity is based on three physiologic levels: low weight, low pulse rate and low blood pressure.—Current Comment, *J.A.M.A.,* 113:2062, December 2, 1939.

1. Robinson, S. C., and Brucer, Marshall: Range of Normal Blood Pressure. *Arch. Int. Med.,* 64:409, September 1939.

## The Radiopaque Surface Layer of Enamel and Caries

By Edmund Applebaum

This paper discusses the apparent hypercalcified outer layer observed on enamel in roentgenographic study of ground sections and microphotometer experiments. The author illustrates typical sections as studied by grenz-ray pictures and is of the opinion that it is not an artefact. The progress of caries is studied, and it is possible to demonstrate the persistence of the radiopaque white line on the surface of the lesion. Various theories are advanced as to the significance of the phenomenon, one being that the decalcified surface layer of enamel has been "remineralized" by saliva.—*J. D. Res.,* 19: 41, February 1940.

Virgil D. Cheyne.

## Composition of Precolumbian Teeth

By Ethel L. French, Helen Tefft, Margaret Rathbun, Jane Eckhardt, Eileen Welch and Harold C. Hodge

The enamel and dentin of thirty-two precolumbian Indian teeth were examined separately for calcium, phosphorus and carbon dioxide content. The average percentage values for enamel are: calcium, 37.1; phosphorus, 17.6; carbon dioxide, 1.98; calcium: phosphorus, 2.12 (inorganic, 98 per cent of dry weight). The average percentage values

for dentin are: calcium, 35.7; phosphorus, 16.6; carbon dioxide, 3.31; calcium:phosphorus, 2.15 (inorganic, 80 per cent of dry weight). The constancy of composition of precolumbian teeth is noteworthy. The mol compositions of the mineral phase of precolumbian enamel and dentin are nearly the same as those of modern and fossil teeth. Evidently, the superiority in dental health of these tribes did not lie in chemical differences in tooth composition.—*J. D. Res.*, 18: 547, December 1939.

H. C. Hodge.

## Intravenous Anesthesia in Office Practice for Operations in Exodontia and Oral Surgery: Based on Experience of 946 Cases

By Oran K. Bullard

Two barbituric acid derivatives, pentothal sodium and epival soluble, seem especially suitable for general anesthesia in office practice. The author has used the former in 718 and the latter in 228 carefully selected cases.

Premedication is not necessary, but atropine sulfate one-one-hundred-fiftieth grain (to control laryngospasm) and morphine sulfate one-sixth to one-quarter grain may be used in combination. Should the systolic blood presure be below 100, ephedrine sulfate three-eighths grain is injected intramuscularly, and sufficient time is allowed to elapse until the blood pressure is raised to a satisfactory level.

These drugs are contraindicated for operations of long duration. They should never be used for deep infections in the floor of the mouth and in the neck because of possible accident due to the presence of a hypersensitive carotid sinus reflex.

The patient should be placed in a reclining rather than a sitting position. Means of resuscitation should be near at hand. On anesthetizing the patient, the tongue is pulled forward, the throat packed to prevent aspiration of débris and the mandible supported and held forward.

Immediate postoperative care consists of ventilating the lungs with nitrous oxide and oxygen for several minutes. When the patient is fully conscious, he is provided with a cup of black coffee, with or without sugar.

In case of laryngospasm during anesthesia, the immediate administration of nitrous oxide and oxygen has proved helpful. In case of respiratory failure, the following measures are resorted to in the order named: administration of: oxygen, with artificial respiration; picrotoxin (0.3 per cent solution), and metrazol (10 per cent solution), 1 cc. per minute intravenously.—*Anesth. & Analg.*, 19:26, January-February 1940.

William J. Manion.

## Some Observations on the Tusks of an Indian Elephant; the Innervation of the Pulp

By Harold L. Weatherford

The tusk is a persistently growing tooth. Both medullated and non-medullated fine nerve fibers enter the pulp at the growing end and proceed toward the apex in small fasciculi of three to ten fibers. Peripherally, the fibers lose their medullary sheaths beneath the layer of odontoblasts and terminate in simple beadlike endings at various levels in the odontoblastic layer. None is traced beyond the peripheral ends of the bodies of the cells.—*Anat. Rec.*, 76:81, January 1940.

Martin Deakins.

## Toxic Effects of Sulfanilamide

By Gilbert J. Levy

A study has been made of the amount of sulfanilamide dispensed at the John Gaston Hospital, Memphis, Tenn. A total of 3,000,000 grains was dispensed during one year. One 5-grain tablet was dispensed for every one of aspirin. The average dose in the Genito-Urinary Department was 870 grains over a period of seventeen days. It is not unusual for a patient to receive 1,500-3,000 grains before discontinuing the drug. Study of some of the effects as reported by members of the medical society were: mild toxic symptoms, such as headache, nausea, weakness, malaise, anorexia, vertigo and cyanosis, which can be easily identified and controlled. These symptoms should not cause concern.

Marked dyspnea, extreme cyanosis, severe abdominal pain, mental confusion, diarrhea, fever, skin eruptions, slowly developing anemia and lowering carbon dioxide tension are dangerous manifestations. Dosage should be reduced immediately or be discontinued. Acute hemolytic anemia, neutropenia, jaundice and optic neuritis demand immediate

discontinuance of the drug, with daily examination of the blood and emergency measures such as forcing fluids, blood transfusion, oxygen inhalations and pentnucleotide injections. Intravenous methylene blue is of much value in combating methemoglobinemia.—*South. M. J.*, 33:212, February 1940.

N. S. Simmons.

## Calcium Metabolism and the Teeth

By Rudolf Kronfeld

The author states that the deciduous teeth begin to calcify at from 4 to 6 months *in utero*. The amount of enamel and dentin present at birth can be determined by the prenatal ring, which is an incremental ring dividing prenatal from postnatal tooth formation. Disturbances of the deciduous teeth are usually confined to the postnatal period, for, during pregnancy, the mother is able to supply sufficient calcium for proper development. At present, it is believed that the condition of the mother during pregnancy has but little influence as far as the child's teeth are concerned, for it is doubtful whether the condition of the mother can alter the tooth structure of the offspring. After birth, however, the child often suffers from illness and metabolic disturbances which may result in hypoplasia of the deciduous teeth.

Calcification of the permanent teeth begins at birth with the cusps of the first permanent molars. Enamel hypoplasia of the permanent teeth is due to postnatal conditions which disturb the calcium metabolism. The most important of these are rickets (vitamin D deficiency) and tetany (disturbed parathyroid function). Only those portions of the teeth which are calcifying at the time of the disturbance become hypoplastic. This holds true also in fluorosis; for once enamel formation is completed, fluorine ingestion does not noticeably affect the teeth. There is no evidence that calcium can be withdrawn from the teeth from within. Only conditions outside the teeth can effect withdrawal. Similarly, there is no statistically valuable evidence that, during pregnancy, calcium can be withdrawn from the mother's teeth; nor is there any evidence, which could not be explained by external conditions, that the incidence of caries during pregnancy is greater than in non-pregnant women of the same age. It is evident, therefore, that attempts to improve the structure of erupted teeth by means of calcium, phosphorus or vitamins are useless.

The author includes a chronology of the human dentition.—*Mil. Surgeon*, 86:250, March 1940.

S. Finn.

## Saliva: A Short Account of a Property Previously Undescribed

By Paul Pincus

The author mentions the fact that he has noted a property of saliva that will reduce methylene blue and dichlorphenol-iodophenol to the colorless form in a few seconds. There is some evidence that this property is not due to the bacteria present. If saliva is heated to 55° C. for five minutes, the time taken to reduce the latter dye is increased 6 times, and such saliva is not sterile. Enzyme poisons, such as hydrocyanic or iodoacetic acid, will prolong the reduction time from less than one minute to more than an hour, many bacteria still being present and viable.

The author suggests a possible relationship between this effect and the presence or perpetuation of anaerobic organisms, such as Vincent's. "If caries and pyorrhea are of bacterial origin, this reducing power is a factor that must be taken into account."—*Brit. D. J.*, 58:96, February 1, 1940.

N. S. Simmons.

## Studies on the Acid Solubility of Human Enamel

By Joseph Volker

A study was made of the acid solubility of different types of human enamel using a gradimetric technic. No striking difference in solubility in young and in old permanent enamel was evident, although the experimental data suggested a decreased enamel solubility with age. Enamel from carious and from non-carious teeth was not appreciably different in its resistance to solution by acid. The solubility values obtained for unerupted tooth enamel and for erupted tooth enamel were comparable.—*J. D. Res.*, 19:35, February 1940.

Joseph Volker.

# ANNOUNCEMENTS

ANNOUNCEMENTS must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

## CALENDAR OF MEETINGS

AMERICAN ACADEMY OF PERIODONTOLOGY, Cleveland, Ohio, September 5-7.

AMERICAN ACADEMY OF RESTORATIVE DENTISTRY, Cleveland, Ohio, September 7-8.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF ORAL DIAGNOSIS, October 17-18, New York, N. Y.

AMERICAN ASSOCIATION OF ORTHODONTISTS, Chicago, Ill., May 13-16.

AMERICAN BOARD OF ORTHODONTICS, Chicago, Ill., May 11.

AMERICAN DENTAL ASSISTANTS ASSOCIATION, Cleveland, Ohio, September 9-12.

AMERICAN DENTAL ASSOCIATION, Cleveland, Ohio, September 9-13.

AMERICAN DENTAL HYGIENISTS' ASSOCIATION, Cleveland, Ohio, September 9-13.

AMERICAN PUBLIC HEALTH ASSOCIATION, Detroit, Mich., October 8-11.

AMERICAN SOCIETY FOR THE PROMOTION OF DENTISTRY FOR CHILDREN, Cleveland, Ohio, September 9.

AMERICAN SOCIETY OF ORAL SURGEONS AND EXODONTISTS, Cleveland, Ohio, September 6-7.

CANADIAN AND ONTARIO DENTAL ASSOCIATIONS, Toronto, May 27-29.

DISTRICT OF COLUMBIA DENTAL SOCIETY, second and fourth Tuesdays in each month from October to June at the United States Public Health Service Auditorium, Washington.

FIVE STATE POST GRADUATE CLINIC, Washington, D. C., May 19-23.

GREATER NEW YORK DENTAL MEETING, New York, December 2-6.

NATIONAL BOARD OF DENTAL EXAMINERS, May 6-7.

NATIONAL DENTAL ASSOCIATION, St. Louis, Mo., August 12-16.

NEW YORK UNIVERSITY DENTAL COLLEGE CLASS OF 1905, New York, May 22.

NORTH ATLANTIC ORTHODONTIC SOCIETY, New York, N. Y., May 1.

OHIO STATE UNIVERSITY ALUMNI, Columbus, April 17-18.

DENTAL ALUMNI SOCIETY, University of Pennsylvania, Philadelphia, September 19.

ALUMNI SOCIETY OF THE PHILADELPHIA DENTAL COLLEGE, Philadelphia, May 22-23.

QUEENS DISTRICT DENTAL SOCIETY, Great Neck, N. Y., June 26.

ANNUAL TEMPLE DENTAL ALUMNI MEETING, Philadelphia, Pa., May 22-23.

WISCONSIN STATE DENTAL ECONOMIC STUDY CLUB, Madison, August 2-3.

## STATE SOCIETIES

### May

Arkansas, at Little Rock (20-22)
California State, at Oakland (13-15)
District of Columbia, at Washington (19-23)
Georgia, at Macon (14-16)
Illinois, at Springfield (13-16)
Indiana, at Indianapolis (20-22)
Iowa, at Des Moines (6-8)
Montana, at Billings (2-4)
Nebraska, at Lincoln (20-23)
New Jersey, at Asbury Park (8-10)
New York, at Buffalo (14-17)
North Carolina, at Charlotte (6-8)
South Carolina, at Spartanburg (20-21)
South Dakota, at Sioux Falls (12-14)
Tennessee, at Memphis (13-16)
Vermont, at Burlington (15-16)
Virginia, at Lynchburg (13-15)
West Virginia, at Charleston (20-22)

### June

Colorado, at Colorado Springs (20-22)
Connecticut, at New London (5-7)
Idaho, at Sun Valley (24-26)
Maine, at Lakewood (23-25)
Nevada, at Reno (8)
New Hampshire, at North Conway
New Mexico, at Santa Fe
Oregon, at Portland (12-15)
Pennsylvania, S. S. South American (13-16)

Utah, at Salt Lake City
Wyoming, at Rock Springs

August

Hawaii, at Honolulu

October

Southern California, at Los Angeles

November

Florida, at St. Petersburg (11-13)
Ohio, at Cincinnati

## STATE BOARDS OF DENTAL EXAMINERS

Alabama, at Birmingham, June 24. W. A. Wood, 1004 Merchants National Bank Bldg., Mobile, Secretary.

Arkansas, at Little Rock, June 17-20. Clarence W. Koch, 817 Donaghey Bldg., Little Rock, Secretary.

Arizona, at Phoenix, July 10-13. R. A. McCall, 719 Professional Bldg., Phoenix, Secretary.

California, at San Francisco, June 3, and at Los Angeles, June 24. Kenneth I. Nesbitt, 515 Van Ness Ave., San Francisco, Secretary.

Connecticut, at Hartford, June 25-29. Almond J. Cutting, Southington, Recorder.

Delaware, at Wilmington, June 5-7. Charles R. Jefferis, Medical Arts Bldg., Wilmington, Secretary.

Florida, at Jacksonville, June 24. H. B. Pattishall, 351 St. James Bldg., Secretary.

Indiana, at Indianapolis, June 4-7. J. M. Hale, Mt. Vernon, Secretary.

Kentucky, at Louisville, June 5-8. Leon M. Childers, 1312 First National Bank Bldg., Lexington, Secretary.

Louisiana, at New Orleans, June 11-15. Joseph L. Webre, 740 Audubon Bldg., New Orleans, Secretary.

Minnesota, at Minneapolis, June 17-22. Elmer J. Sundby, 805 Medical Arts Bldg., Duluth, Secretary.

Mississippi, at Jackson, June 18. A. B. Kelly, Yazoo, Secretary.

Montana, at Helena, July 8. Leonard A. Jenkin, 401 Ford Bldg., Great Falls, Secretary.

Nebraska, at Lincoln, June 17-22. Leonard R. Johnston, 916 Stuart Bldg., Lincoln.

New Jersey, June 24-29. Walter A. Wilson, 148 W. State St., Trenton, Secretary.

New Mexico, at Albuquerque, June 26-29. J. J. Clark, Sr., Artesia, Secretary.

North Carolina, at Raleigh, June 24. Wilbert Jackson, Rich Building, Secretary.

North Dakota, at Fargo, July 8-11. L. I. Gilbert, 401 Black Bldg., Fargo, Secretary.

Ohio, at Columbus, June 24-28. Morton H. Jones, 1553½ North Fourth St., Columbus, Secretary.

Oklahoma, at Oklahoma City, June 17-20. W. T. Longwell, Frederick, Secretary.

Pennsylvania, at Pittsburgh and Philadelphia, June 18-22. Reuben E. V. Miller, 61 North Third St., Easton, Secretary.

Rhode Island, at Providence, June 25-27. Philip J. Conley, 2 Old Colony Bldg., West Warwick, Secretary.

South Carolina, June 17-19. T. C. Sparks, Columbia, Secretary.

South Dakota, at Sioux Falls, June 24-27. C. H. Boyden, Mitchell, Secretary.

Texas, at Houston, June 17-21. B. Carl Holder, 1009 Nixon Bldg., Corpus Christi, Secretary.

Vermont, at Montpelier, June 24-26. C. I. Taggart, 139 Bank St., Burlington, Secretary.

Virginia, at Richmond, June 11. John M. Hughes, 715 Medical Arts Bldg., Richmond, Secretary.

Wisconsin, at Milwaukee, June 17-21. S. F. Donovan, Tomas, Secretary.

## FLORIDA STATE DENTAL SOCIETY

THE Florida State Dental Society will hold its 1940 state meeting at St. Petersburg, in the Princess Martha Hotel, November 11-13.

E. B. PENN, *President*,
618 Dupont Bldg.,
Miami.

## ARIZONA STATE DENTAL BOARD

THE Arizona State Dental Board will conduct its annual examination July 10-13 in Phoenix. Applications, fees and credentials must be in the hands of the secretary not later than fifteen days prior to the examination date. For application blanks and further information, address

R. A. McCall, *Secretary*,
719 Professional Bldg.,
Phoenix.

## CONNECTICUT DENTAL COMMISSION

THE Connecticut Dental Commission will meet in Hartford June 25-29 for the examination of applicants for license to prac-

tice dentistry or dental hygiene and to transact any other business proper to come before it. Applications should be in the hands of the recorder at least ten days before the meeting. For application blanks and further information, apply to

ALMOND J. CUTTING, *Recorder,*
Southington.

## KENTUCKY STATE BOARD OF DENTAL EXAMINERS

THE next examination of the Kentucky State Board of Dental Examiners will be held June 5-8 in Louisville. Address all communications to

LEON M. CHILDERS, *Secretary,*
1312 First National Bank Bldg.,
Lexington.

## LOUISIANA STATE BOARD OF DENTISTRY

THE next examination of the Louisiana State Board of Dentistry for license to practice dentistry and dental hygiene will be held in New Orleans, June 11-15, at Loyola University. All credentials must be in the office of the secretary at least twenty days prior to the examination. Address all communications to

JOSEPH L. WEBRE, *Secretary,*
740 Audubon Bldg.,
New Orleans.

## STATE OF MINNESOTA BOARD OF DENTAL EXAMINERS

THE next Minnesota State Dental Board examinations will be held at the College of Dentistry, University of Minnesota, Minneapolis, June 17-22.

ELMER J. SUNDBY, *Secretary,*
805 Medical Arts Bldg.,
Duluth.

## NEBRASKA STATE BOARD OF DENTAL EXAMINERS

EXAMINATIONS for license to practice dentistry in the State of Nebraska will be held in Lincoln, June 17-22. All applications must be filed with the Bureau of Examining Boards, Lincoln, at least fifteen days before the examination.

LEONARD R. JOHNSTON, *Secretary,*
916 Stuart Bldg.,
Lincoln.

## NEW MEXICO BOARD OF DENTAL EXAMINERS

THE next meeting of the New Mexico Board of Dental Examiners will be held June 26-29 in Albuquerque. For information concerning this meeting, address

J. J. CLARKE, SR., *Secretary,*
Artesia.

## DENTAL COUNCIL AND EXAMINING BOARD OF COMMONWEALTH OF PENNSYLVANIA

THE Dental Council and Examining Board of the Commonwealth of Pennsylvania will conduct examinations in Philadelphia and Pittsburgh, June 18-22. For information and applicant blanks, address the Department of Public Instruction, Bureau of Professional Licensing, Dental Division, Harrisburg, or

REUBEN V. MILLER, *Secretary,*
61 North Third St.,
Easton.

## SOUTH DAKOTA BOARD OF DENTAL EXAMINERS

(Correction)

THE South Dakota Board of Dental Examiners will meet at the Carpenter Hotel, Sioux City, June 24-27, to examine applicants for license to practice dentistry. Applications should be in the hands of the secretary thirty days before the date of the meeting. For further information, write to

C. H. BOYDEN, *Secretary,*
Mitchell.

## VERMONT STATE BOARD OF DENTAL EXAMINERS

THE Vermont State Board of Dental Examiners will meet June 24-26 in the State House, Montpelier, to examine applicants for license to practice dentistry and dental hygiene. All applications, together with examination fee, must be in the hands of the secretary at least fifteen days before the date of the meeting. Address all communications to

C. I. TAGGART, *Secretary,*
139 Bank St.,
Burlington.

## VIRGINIA STATE BOARD OF DENTAL EXAMINERS

THE next regular meeting of the Virginia State Board of Dental Examiners will be held

at the Medical College of Virginia, Richmond, beginning promptly at 9 a.m., June 11. Applicants are required to present a certificate from the Virginia State Board of Education showing that they have had one year of academic education equal to one year of college work, must be graduates of a class A dental college or university and must be prepared to do any kind of practical or operative work necessary in the general practice of dentistry. The theoretical examination covers subjects usually found in a complete dental curriculum. Applications, with fee and photograph, must be filed, complete, fifteen days before the examination. For application blanks and further information, apply to

JOHN M. HUGHES, *Secretary,*
715 Medical Arts Bldg.,
Richmond.

## AMERICAN ACADEMY OF RESTORATIVE DENTISTRY

THE American Academy of Restorative Dentistry will meet at the Hotel Cleveland, Cleveland, Ohio, September 7-8.

W. S. TUCKER, *Secretary,*
940 Canal Bank Bldg.,
New Orleans, La.

## AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF ORAL DIAGNOSIS

THE annual meeting of the American Association for the Advancement of Oral Diagnosis will be held October 17-18 at the Academy of Medicine, 2 East 103d St., New York, N. Y. This meeting will be held at the end of the first week of the Graduate Fortnite of the Academy. Both physicians and dentists who are members in good standing of their respective organizations in the countries (Western Hemisphere) in which they practice are eligible for membership in the association. The constitution provides for the organizing of regional divisions by members of both professions, these divisions being components of the American Association for the Advancement of Oral Diagnosis. For further information and membership blanks, address

H. JUSTIN ROSS, *Secretary,*
515 Madison Ave.,
New York, N. Y.

## AMERICAN SOCIETY FOR THE PROMOTION OF DENTISTRY FOR CHILDREN

THE fourteenth annual meeting of the American Society for the Promotion of Dentistry for Children will be held September 9 at the Cleveland Hotel, Cleveland, Ohio. All members of the American and Canadian Dental associations are invited.

RALPH L. IRELAND, *Secretary,*
College of Dentistry,
University of Nebraska,
Lincoln, Nebr.

## NATIONAL DENTAL ASSOCIATION

THE National Dental Association will hold its twenty-seventh convention, August 12-16 in St. Louis, through the cooperation of the local chapter, the Mound City Dental Society. For further information, address

J. A. JACKSON, *Secretary,*
406 Commerce St.,
Charlottesville, Va.

## QUEENS DISTRICT DENTAL SOCIETY

THE Queens District Dental Society, a component of the Dental Society of the State of New York and the American Dental Association, will hold its sixth annual all day outing at the Lakeville Club, June 26, Great Neck, L. I. The cost of the day's outing will be $6 per person including golf green fees, sports events and dinner. For reservations, send check made payable to Herbert Taub, 83-28 Parsons Blvd., Jamaica, N. Y.

## NEW YORK UNIVERSITY DENTAL COLLEGE CLASS OF 1905

THE Class of 1905, New York University Dental College, will hold a reunion dinner May 22 at 7 p.m., in the Fifth Avenue Hotel, New York, N. Y. The dinner will be informal and the tickets are $2.50 each.

MAX HERBST, *Chairman,*
Dinner Committee,
875 West End Ave.,
New York.

## ANNUAL TEMPLE DENTAL ALUMNI MEETING

THE seventy-seventh annual session of the Alumni Society of the Philadelphia County Dental College (Temple University School of Dentistry) will be held May 22-23.

The program has been planned to make a survey of progress in dentistry in recent years. Practical clinic demonstrations will be presented by members of the Alumni Association as well as various speakers of note. The reunion banquet, Penn Athletic Club, will be addressed by Gen. Smedley D. Butler. For further information, address

DAVID K. WALDMAN,
5203 Chester Ave.,
Philadelphia, Pa.

## DENTAL INFORMATION BUREAU

(Change of Name)

THE Greater New York Bureau for Dental Information announces a change of name to the Dental Information Bureau, "an official source of dental information sponsored by dentistry." The address is 730 Fifth Ave., New York, N. Y. C. Franklin MacDonald, 501 Madison Ave., is chairman.

## GREATER NEW YORK DENTAL MEETING

THE Greater New York Dental Meeting will be held December 2-6 at the Hotel Pennsylvania, New York, N. Y.

WALTER A. QUINN, *Chairman*,
Press and Publication,
Room 106A,
Hotel Pennsylvania,
New York.

## PUBLICATION AND SALE OF THE PROCEEDINGS OF THE DENTAL CENTENARY CELEBRATION HELD AT BALTIMORE, MD., MARCH 18, 19, 20, 1940

A COMPLETE report of the transactions of the Dental Centenary will be printed in book form, approximately 800 pages, 400 cuts attractively arranged and carefully edited, indexed and ready for use. A record of this important event in dental history will be one of the most valuable features of the future library. The Centenary Committee has arranged for the sale of the proceedings, subject to future delivery. In order to encourage wide distribution of the text, it is offered at $5 a copy.

Send subscriptions to

EARL W. SWINEHART, *Chairman*,
Publicity Committee,
Medical Arts Bldg.,
Baltimore, Md.

## AMERICAN DENTAL HYGIENISTS' ASSOCIATION

THE next annual meeting of the American Dental Hygienists' Association will be held in Cleveland, Ohio, September 9-13, with headquarters at the Hotel Carter.

A. REBEKAH FISK, *Secretary*,
Walter Reed Gen. Hospital,
Washington, D. C.

## EXAMINATION FOR APPOINTMENT IN THE DENTAL CORPS OF THE NAVY

A COMPETITIVE examination to select not more than twenty for appointment in the Dental Corps of the Navy will be held July 8 at the Naval Medical School, Washington, D. C.; Naval Training Station, Great Lakes, Ill., and Naval Training Station, San Diego, Calif. A candidate for appointment in the Dental Corps must be a citizen of the United States, between 21 and 32 years of age at the time of appointment and a graduate of a standard dental college. A circular which contains full information relative to the Dental Corps and describes the method of making application for appointment can be obtained from the Bureau of Medicine and Surgery, Navy Department, Washington, D. C.

## DENTAL INTERNSHIP

APPLICATIONS are now in order for appointment to a twelve-month internship, beginning July 1, at St. Luke's Hospital, Morningside Heights, New York, N. Y. The dental intern will be instructed in a wide variety of dental activities. Applications should be made as soon as possible, stating qualifications. In applying, address

JEROME M. SCHWEITZER, D.D.S.,
Chief of Dental Department.

# UNITED STATES PATENTS APPLICABLE OR PERTAINING TO DENTISTRY ISSUED DURING FEBRUARY AND MARCH 1940

*February 6*

No. 2,189,175, to Charles Joseph Frederick Jackson. Dental massaging, cleaning, and medicating device.

No. 2,189,299, to Irwin C. Rinn. Film pack, especially for dental films and the like.

No. 2,189,404, to Raemer R. Renshaw and Paul F. Dreisbach. Anesthetic of the pyridine series and method for producing the same.

No. 2,189,408, to Theodore Seifried. Mechanically operated toothbrush.

No. 2,189,571, to Cecil Spencer Sivil and Edward O. Liebig. Alloys.

*February 13*

No. 2,189,891, to Addison H. Flournoy. Rotating toothbrush.

No. 2,190,277, to Stephen Viragh. Dental brush.

*February 20*

No. 2,191,402, to Jacob A. Saffir and Henry G. Bartsch. Photographic illuminating equipment.

*February 27*

No. 2,192,103, to Alexander P. Preston. Dental mouth mirror.

*March 5*

No. 2,192,429, to John L. Bloomheart. Gas administration.

No. 2,192,558, to James B. Poindexter. Tooth guard and jaw protector.

*March 12*

No. 2,192,902, to Reiner W. Erdle. Method of molding dentures.

No. 2,193,021, to Herbert J. Dietz. Mounting for x-ray intensifying screens.

No. 2,193,249, to Fred L. Flanders and James J. McGerry. Gum massaging device.

No. 2,193,322, to Matthew Lozier and Clayton Herbert Frost. Controllable transfer element for multiple compartment ampoules.

No. 2,193,357, to August S. Greth. Investment ring.

No. 2,193,489, to Mendel Nevin. Hypodermic syringe, medicament container therefor and method for preparing same.

*March 19*

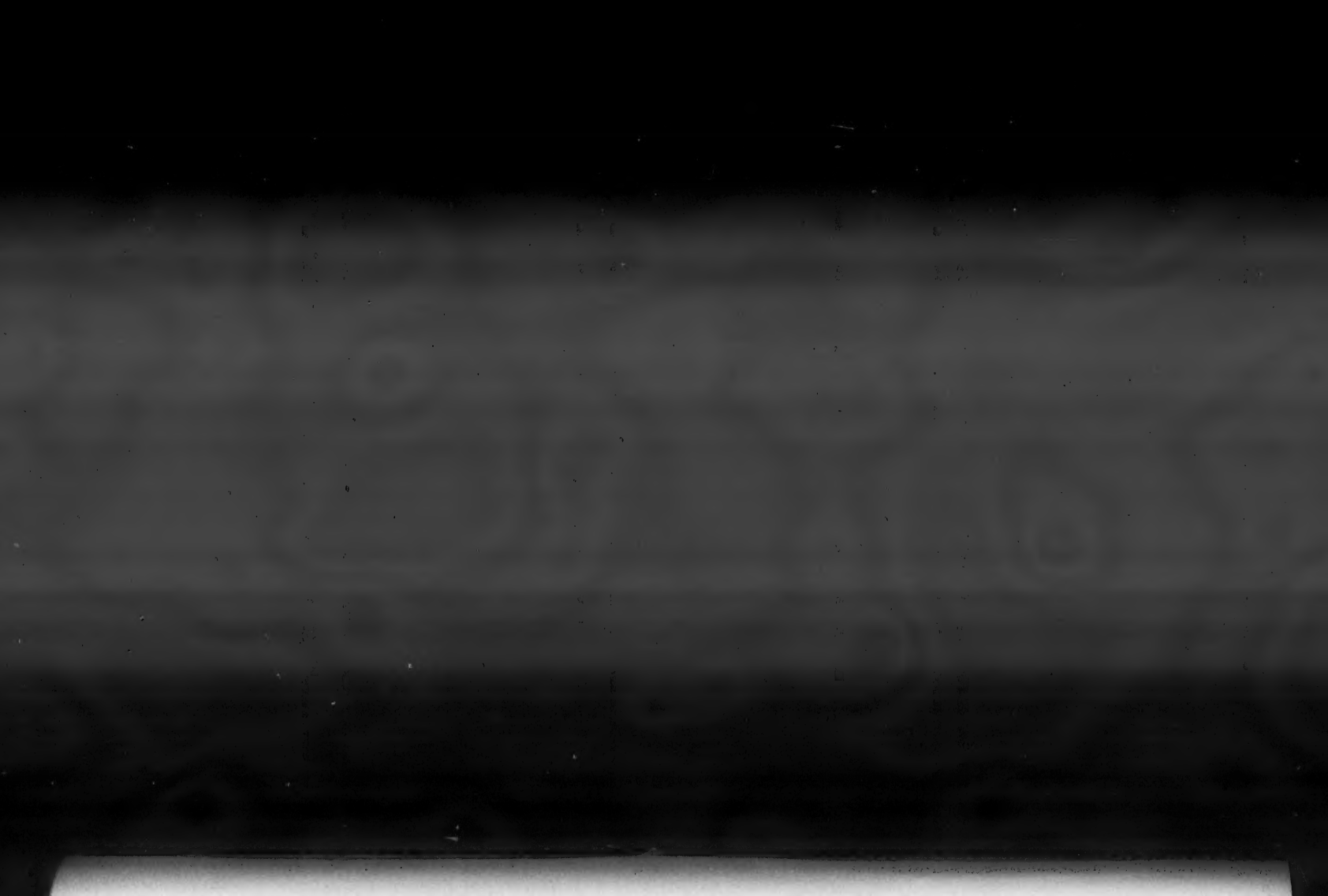
No. 2,193,988, to John R. Sheppard. Artificial tooth carrier.

No. 2,193,993, to Andre de Weal. Method of and apparatus for making dental radiographs.

No. 2,194,187, to Perry R. Skinner. Angle dental handpiece.

*March 26*

No. 2,194,790, to Jenö Glück. Artificial tooth and crown of tooth.

No. 2,195,370, to John B. La Due and Jacob A. Saffir. Artificial tooth.

No. D-119,626-631, to John B. La Due and Jacob A. Saffir. Design for an artificial tooth.